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YEARBOOK 1975

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ROYAL AIR FORCE YEARBOOK 1975

INTRODUCTION
by the Chief of the Air Staff, Air Chief Marshal Sir Andrew Humphrey, GCB, OBE, DFC, AFC, ADC.

IT IS FITTING, I think, that after so many years in its old form, the Royal Air Force Souvenir Book should take on a new image, and be replaced by the Royal Air Force Yearbook. The objectives remain the same – to present the Royal Air Force to the public, and to raise funds for the Royal Air Force Benevolent Fund and the Royal Air Forces Association, and I believe that the substantial form and the professional construction of this Yearbook will achieve those aims more readily. The editors have set out to interest and entertain a wide readership. I think that is right. At a time when the rôles of the Royal Air Force are becoming more important than ever, and when the need for an effective Air Force is fully recognised by the Government and the defence establishment, it is vital, I think, that we strive to gain wider acceptance of the importance of air power among the public at large.

The last year has not been an easy one for the country or the Air Force. Defence expenditure has had to be reduced and strategic aims have been revised. The resulting defence review has led to the closure of distinguished units and the redundancy of many loyal and dedicated men. Withdrawals from overseas and contractions at home will give rise to turbulence which will affect many people during the next few years.

These changes are painful, but if we carry them through with resolution and vigour, the Royal Air Force will emerge in many ways stronger and better – and certainly better balanced – than it has been for many years. Its combat strength will be greater and its combat rôles and functions more clearly defined; promotion blockages will have been cleared and career prospects should be distinctly brighter.

Looking ahead, we must concentrate our resources, which are bound to be limited, on two things: firstly the equipment – the aircraft, weapons and communications – necessary for our operational tasks, and secondly those things which will ensure that we continue to attract men and women of the highest quality. Without them, equipment, however good, has no value; and this also means providing first-class training, good pay, good housing, and all the multitude of factors that make us proud to be part of the Air Force. We have a record of success in international competitions and displays which is second to none and that is the way we will keep it.

So I hope that all who read this Yearbook will draw from it the impression of a fighting Service, jealous of its proud tradition, yet looking forward with great confidence to a no less exciting and active future. I wish you good reading.

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After the defence cuts . . .

THE RAF— Lean yet potent

By John Fricker

IN THE SHRINKING WORLD of British defence commitments, to be shaped over the next few years by drastic reductions in planned military expenditure, the Royal Air Force, of all British Services, is most affected by the Government's recent searching defence review. Apart from physical contraction resulting from the loss of 50 per cent of its fixed-wing transport fleet, and nearly 25 per cent of its maritime patrol and tactical helicopter force, together with an 18,000-personnel pruning over the next three or four years, the RAF is having to adjust to a further restructuring of its rôles and task priorities following removal of almost all remaining overseas commitments except those directly concerned with the support of NATO in Europe.

In addition to a wholesale withdrawal from such overseas bases as Singapore, Gan and Mauritius, British forces are being removed from NATO assignment in the Mediterranean from 1976 onwards, while UK membership of the CENTO Pact will in future be purely nominal. The Government's objective is to tailor Britain's defences to an arbitrary reduction in expenditure as a proportion of gross national product from the present 5·7 per cent or so to around 4·5 per cent over the next 10 years, thereby resulting in a claimed saving of some £4,760m at 1974 survey prices. This means that, whereas in real terms there will be a small increase in 1975–6, defence spending is planned to remain broadly at the same level thereafter for the rest of the review period, amounting to about £3,800m from 1976–77 to 1978–79, and £3,790m in the years from 1979–80 to 1983–84.

The recent defence economies are the latest of a number of major policy upheavals which have completely re-shaped the structure of the Royal Air Force over the past few years. Prior to the current defence review, the RAF had to adapt to such changes as the 1967 shift in NATO strategy from nuclear trip-wire to flexible response, with a corresponding change in emphasis from nuclear strike to conventional ground attack; the withdrawal of nearly all permanent UK defence forces from the Far East and Persian Gulf between January 1969, and December 1971; the mid-1969

Panavia MRCA Cutaway Drawing Key

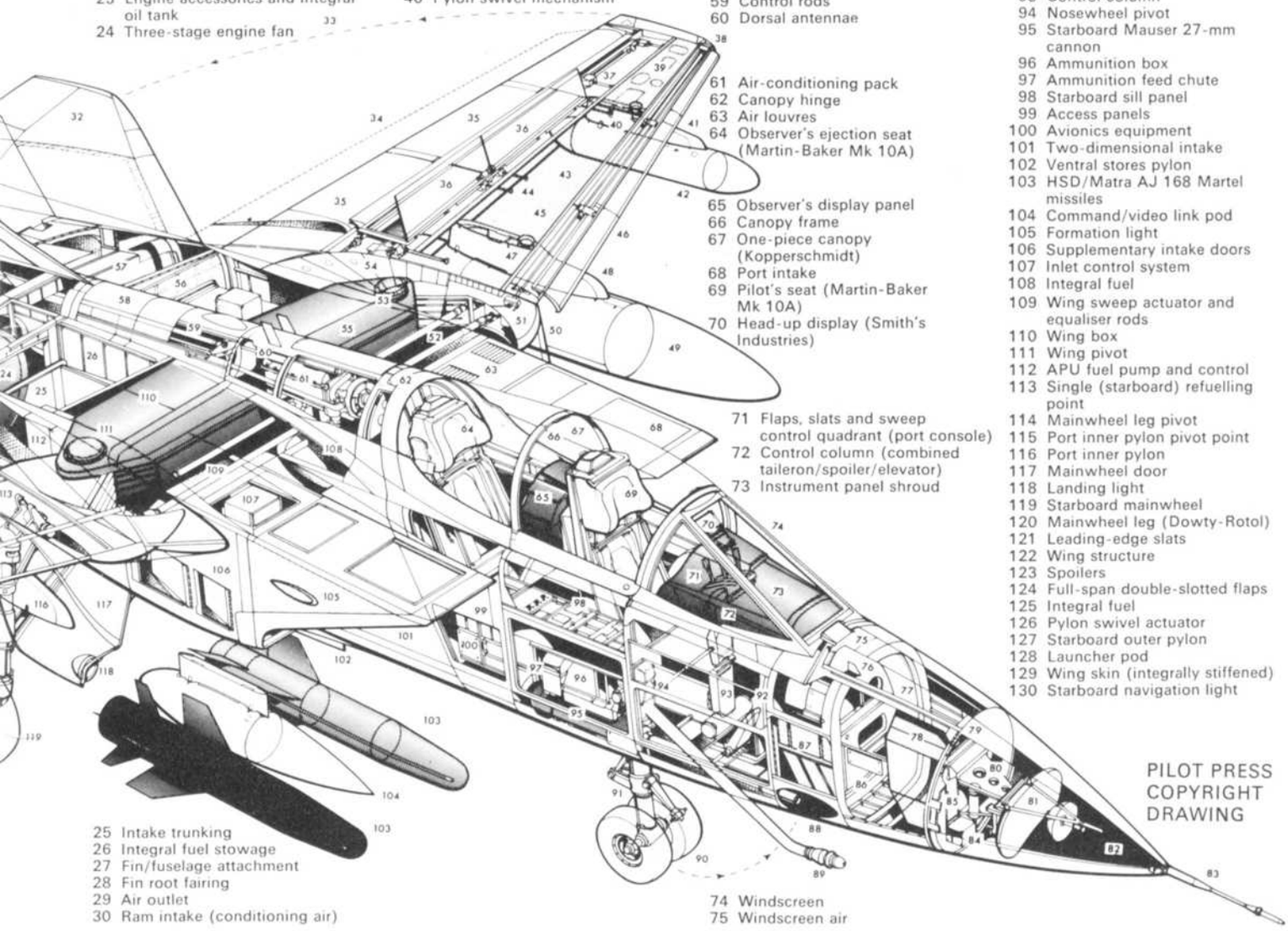
1 Fintip antenna
2 Passive ECM antenna fairings (MSDS/Decca/Plessey)
3 Rear navigation light
4 Plate antenna
5 Antenna housing
6 Tailfin
7 Two-spar fin construction
8 Rudder
9 Rudder lower hinge
10 Fin/fuselage attachment
11 Rudder actuator
12 Convergent nozzle
13 Afterburner
14 Nozzle position indication system

transfer from the RAF V-bomber force to the Polaris-equipped submarines of the Royal Navy of the primary rôle of providing the UK nuclear deterrent; the assumption of responsibility for the air defence of naval forces and the provision of shore-based tactical air support for the fleet.

To these factors had to be added such others as the unification of the Ministry of Defence in 1964, and the establishment of a new command structure within the RAF, reflecting its changed rôles and contracted commitments. In its new streamlined form, the RAF emerged with only three major combat formations: Strike Command, which combines all UK-based operational and support elements within the largest single Headquarters; RAF Germany; and Near East Air Force. NEAF has had its HQ and main units in Cyprus, controlling RAF detachments as far afield as Gibraltar and Gan, and with administrative responsibilities for units in the Far East in Singapore and Hong Kong, but is to lose many of its commitments over the next few years.

Each of these Commands is responsible, through groups and wings, for a number of operational and support squadrons currently totalling about 75, with establishments varying from six to 16 or more aircraft. The present first-line component totals some 54 squadrons, equipped with approximately 750 aircraft, plus some 21 transport and support squadrons, as well as training and communications units which almost double the overall RAF aircraft establishment. The second-line element is due for reductions of up to 50 per cent as a result of the defence review, however, while the number of RAF personnel is scheduled to decrease from 100,000 on 1 April 1974, to 82,000 by the same date in 1979. Among the 18,000 reduction in RAF personnel establishment will be 300–400 pilots, nearly all as a result of the halving of the transport force. Apart from the proposed reduction of almost 25 per cent in the RAF's maritime reconnaissance force of Nimrods, however, its first-line element is currently scheduled to remain virtually unscathed by the recent defence economies.

As the largest single element of the RAF, Strike Command was established on 30 April 1968, with HQ at High Wycombe, Bucks, by the merger of the historic Bomber and Fighter Commands. The latter were effectively downgraded in the new Command to Group status, becoming Nos 1 (Bomber) and 11 (Fighter) Groups respectively, thus retaining some of their wartime nomenclature and associations. Similarly, when the former Signals and Coastal Commands were absorbed, in turn, by the new formation on 1



15 Thrust reverser
16 Runway arrester hook
17 Tailplane structure
18 Tailplane frame
19 Tailplane actuator and pivot
20 Airbrake
21 Machined fuselage frames
22 Turbo-Union RB.199-34R engine
23 Engine accessories and integral oil tank
24 Three-stage engine fan
25 Intake trunking
26 Integral fuel stowage
27 Fin/fuselage attachment
28 Fin root fairing
29 Air outlet
30 Ram intake (conditioning air)
31 Port airbrake (extended)
32 Port elevator/taileron
33 Line of wing sweep
34 Flap position (extended)
35 Full-span double-slotted flaps
36 Spoilers
37 Flap actuator linkage
38 Port navigation light
39 Wing access panels
40 Pylon swivel mechanism
41 Port outer pylon
42 Launcher pod
43 Wing torque box
44 Spoiler actuators (Fairey)
45 Integral fuel
46 Full-span leading-edge slats (extended)
47 Pylon pivot point
48 Port inner pylon
49 Ferry tank
50 Wing sealing glove
51 Slat actuator (Microtécnica)
52 Wing sweep actuator (Microtécnica) and equaliser rods
53 Wing pivot
54 Upper surface wing seal
55 Wing centre-box (Grumman design)
56 Machined fuselage frames
57 Integral fuel (port and starboard)
58 Integral fuel
59 Control rods
60 Dorsal antennae
61 Air-conditioning pack
62 Canopy hinge
63 Air louvres
64 Observer's ejection seat (Martin-Baker Mk 10A)
65 Observer's display panel
66 Canopy frame
67 One-piece canopy (Kopperschmidt)
68 Port intake
69 Pilot's seat (Martin-Baker Mk 10A)
70 Head-up display (Smith's Industries)
71 Flaps, slats and sweep control quadrant (port console)
72 Control column (combined taileron/spoiler/elevator)
73 Instrument panel shroud
74 Windscreen
75 Windscreen air
76 Antenna (offset to starboard)
77 Forward fuselage frame
78 Digital air data computer pack (Microtécnica)
79 Bulkhead
80 Radar mounting
81 Radar array (terrain following and attack – Texas Instruments)
82 Hinged radome (AEG-Telefunken)
83 Pitot head
84 Laser range-finder (Ferranti)
85 Radome hinges
86 Nosewheel well
87 Avionics
88 Starboard cannon port
89 Flight refuelling probe (extended)
90 Forward-retracting twin nosewheels
91 Nosewheel leg (Dowty-Rotol)
92 Rudder pedals
93 Control column
94 Nosewheel pivot
95 Starboard Mauser 27-mm cannon
96 Ammunition box
97 Ammunition feed chute
98 Starboard sill panel
99 Access panels
100 Avionics equipment
101 Two-dimensional intake
102 Ventral stores pylon
103 HSD/Matra AJ 168 Martel missiles
104 Command/video link pod
105 Formation light
106 Supplementary intake doors
107 Inlet control system
108 Integral fuel
109 Wing sweep actuator and equaliser rods
110 Wing box
111 Wing pivot
112 APU fuel pump and control
113 Single (starboard) refuelling point
114 Mainwheel leg pivot
115 Port inner pylon pivot point
116 Port inner pylon
117 Mainwheel door
118 Landing light
119 Starboard mainwheel
120 Mainwheel leg (Dowty-Rotol)
121 Leading-edge slats
122 Wing structure
123 Spoilers
124 Full-span double-slotted flaps
125 Integral fuel
126 Pylon swivel actuator
127 Starboard outer pylon
128 Launcher pod
129 Wing skin (integrally stiffened)
130 Starboard navigation light

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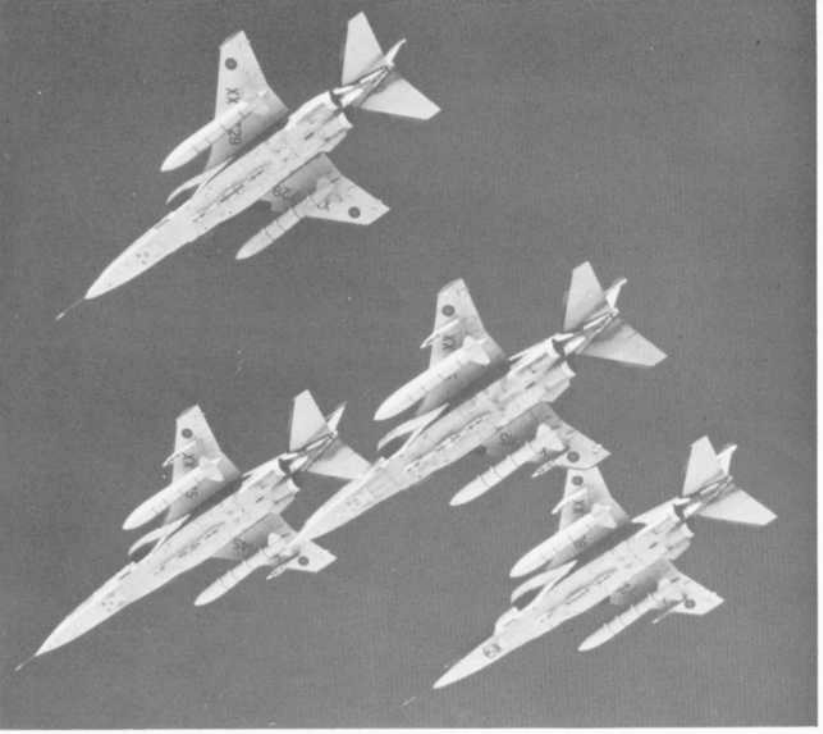


Newest aircraft in the RAF inventory is the SEPECAT Jaguar, which will eventually equip eight operational squadrons, including five in Germany. The illustration above shows four Jaguars of No 6 Squadron in box formation, as they appeared at the Farnborough Air Show in 1974

January and 28 November 1969, respectively, they became known as Nos 90 (Signals) and 18 (Maritime) Groups. No 90 Group's stay was destined to be brief, however, since it was transferred to Maintenance Command on 1 May 1942.

To complete the reorganisation of the home-based RAF operational units into a single multi-rôle command, the tactical strike and transport squadrons of No 38 Group, Air Support Command, were amalgamated with Strike Command on 1 July 1972, as a preliminary to the absorption of the remaining ASC elements – mainly in No 46 Group – on 1 September 1972. Further reorganisation resulted from the formation of Training Command, at Brampton, on 1 June 1968, by the amalgamation of Flying Training and Technical Training Commands, but reduced to single Group strength from its original three. Following studies aimed at further economies in the RAF's support services, reorganisation was largely completed by the absorption of Maintenance Command and No 90 Group into a new Support Command on 1 September 1973, with headquarters at Andover, Hants.

Considerable economies were claimed to have resulted from the RAF reorganisation, particularly where manpower was concerned, but the air element still absorbs almost the largest single amount of expenditure within the £4,548m defence budget, with a total of £874m. This comprises £269m for strike/attack/reconnaissance units; £78m for air defence; £64m for offensive support; £49m for maritime aircraft; £31m for strategic transport; £24m for medium-range transport; £41m for short-range transport; £19m for the air tanker force; £40m for other aircraft; £1m for civil charter; £119m for operational stations and £144m for general support. A further £92m is required for RAF training in the current financial year. Although the proportion of the defence budget available for equipment procurement is scheduled to increase over the next 10 years from its present 35 per cent to around 40 per cent, according to the recent Defence White Paper, total savings on equipment spending are also forecast at up to £3,200m over the same period. This will also include economies of about 10 per cent in R & D expenditure, although most of the main aircraft programmes will be unaffected.

Specific aviation projects on which work is scheduled to continue include a new airborne early-warning system as a follow-up to the present Shackleton and RN Gannet force; methods of improving conventional weapons to increase RAF ground attack capabilities in the 1980s; a new British homing head and fuze for the Sparrow air-to-air missile; new radar, ECM and avionics for the multi-rôle combat aircraft (MRCA); the DN 181 all-weather tracking radar for the Rapier surface-to-air missile; maritime search radars for the RN Lynx and a laser target-marker for forward air controllers.

The RAF is very conscious that its equipment is proportionately among the most expensive of all three Services. In the current budget, for example, RAF equipment appropriations total £651·2m, compared with £337m for land systems, £385·8m for sea systems and £155m for other hardware. Equally, the policy changes resulting in increased operations with conventional weapons will necessitate larger numbers of aircraft to attack any given target to achieve similar effects. The extreme accuracy required in weapon delivery also means more complex and expensive aiming systems, resulting in further cost escalation.

The Strike Force

As currently organised, Strike Command now comprises about 50 squadrons in its five functional Groups, with a total of around 800 aircraft in first- and second-line service. Until earlier this year, certain Strike Command units were earmarked for duty with NATO in an emergency, but from 10 April – when the Command's C-in-C, Air Chief Marshal Sir Denis Smallwood, was also appointed C-in-C UK Air Forces under SACEUR (Gen Alexander Haig, US) – Strike Command's combat forces, and a large proportion of its support forces, were allocated entirely to NATO. Although Strike Command will now take its orders from SACEUR through its RAF C-in-C, the British Government retains overall control and can take over direct command in certain circumstances.

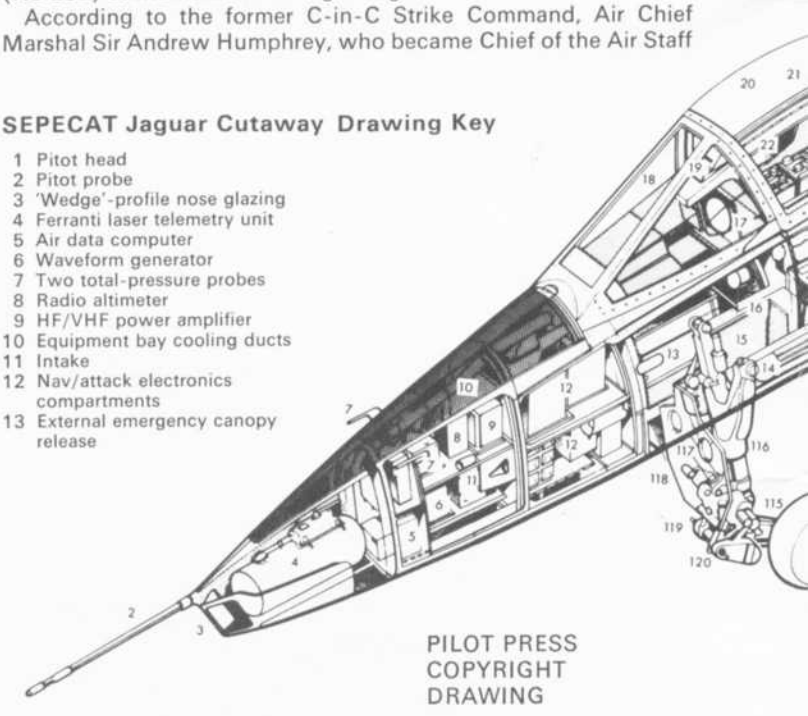
As the long-range spearhead of the Command, No 1 (Bomber) Group exercises day-to-day operational control and the training of a strike force now comprising six squadrons of Vulcan B Mk 2 delta-wing strategic bombers (Nos 9, 35, 44, 50, 101 and 617), plus an Operational Conversion Unit (OCU), based at Scampton and Waddington, in Lincolnshire. Prior to the defence review, the Vulcans of Nos 9 and 35 Sqdns were permanently based at Akrotiri, Cyprus, to form the NEAF Bomber Wing in support of CENTO, but they were withdrawn, together with most of the other Cyprus elements, to the UK at the beginning of this year. Residual tasks in Cyprus will now be met by aircraft on detachment from the UK.

Although the Vulcans still have a nuclear capability and rôle, they are no longer equipped with Blue Steel long-range air-to-surface missiles and their emphasis is on low-level penetration and strike. For conventional rôles, the Vulcan can carry up to 21 1,000-lb (454-kg) HE bombs with parachute retardation for low-level delivery and can operate over very long ranges. These can be further extended by flight-refuelling from the Victors of the Strike Command tanker wing at Marham, which is currently in the process of replacing its K Mk 1 and 1A aircraft with newly-refurbished K. Mk 2s, with something like twice the thrust of the Sapphire-powered Mk 1. About 25 former Handley Page Victor B Mk 2s are currently being converted by Hawker Siddeley at Woodford to K Mk 2 standard and the first were delivered to the Victor OCU (No 232) at Marham at the beginning of 1975.

According to the former C-in-C Strike Command, Air Chief Marshal Sir Andrew Humphrey, who became Chief of the Air Staff

SEPECAT Jaguar Cutaway Drawing Key

1 Pitot head
2 Pitot probe
3 'Wedge'-profile nose glazing
4 Ferranti laser telemetry unit
5 Air data computer
6 Waveform generator
7 Two total-pressure probes
8 Radio altimeter
9 HF/VHF power amplifier
10 Equipment bay cooling ducts
11 Intake
12 Nav/attack electronics compartments
13 External emergency canopy release



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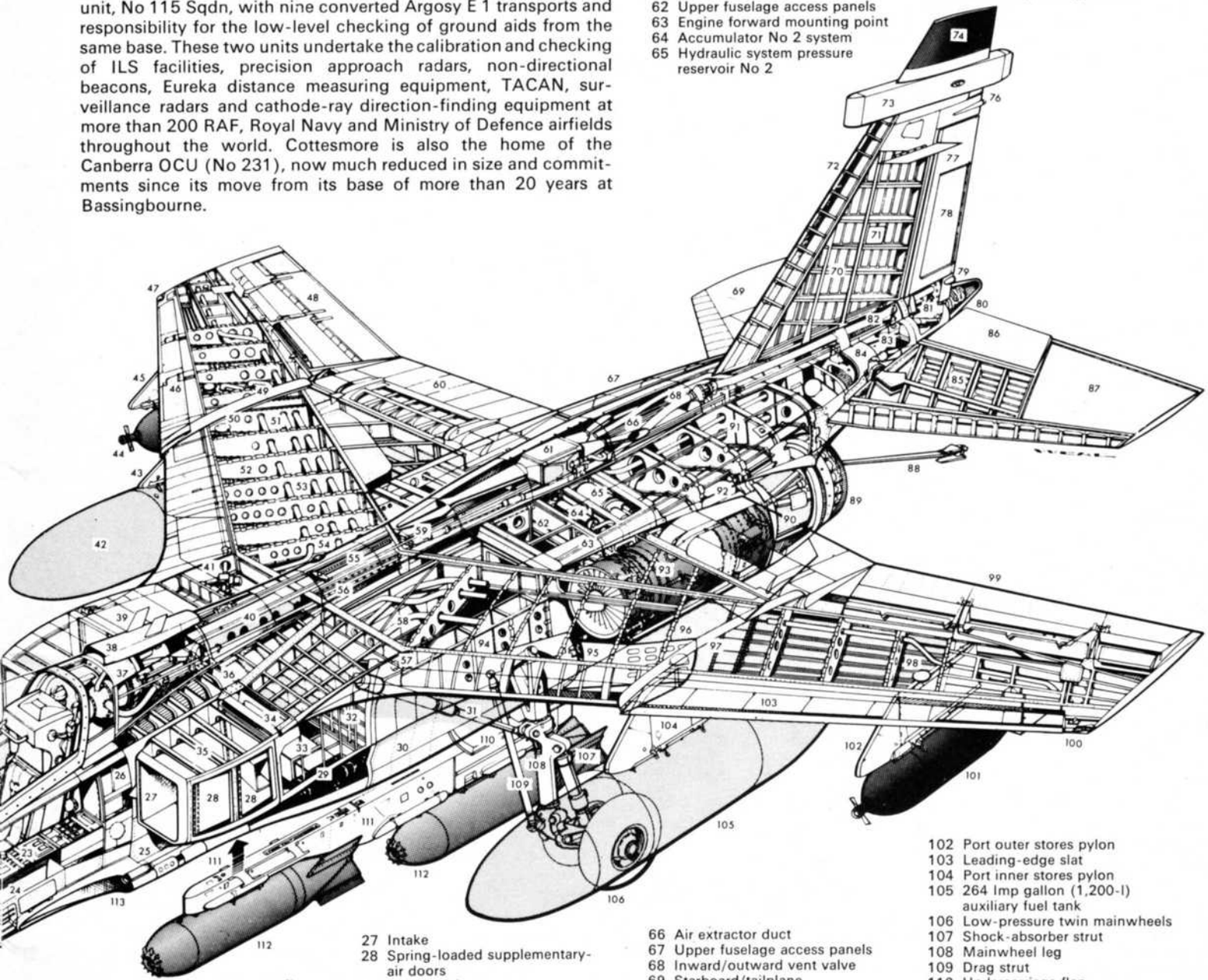
on 1 April 1974, the Vulcan is not visualised as continuing in service much beyond the early 1980s, but is a very long-range aircraft with good radar and navigation systems. There were, he added, many things the Vulcan could be used for, such as maritime radar reconnaissance over strategic ranges.

Strike Command's present strategic reconnaissance force includes only one Vulcan unit – No 27 Sqdn – which was formed at Scampton in late 1973 with an initial batch of five SR Mk 2s to take over from the Victor SR Mk 2s of No 543 Sqdn after its disbandment at Wyton. The latter airfield also houses the high-altitude Canberra PR Mk 9s of No 39 Sqdn, as well as the four Canberra B 6s and three Nimrod R Mk 1s of No 51 Sqdn that are used for various special duties; the dozen or so Canberra T 17s of No 360 Sqdn for similar rôles and the Electronic Warfare School and Support Wing. Associated units within 1 Group include No 98 Sqdn, which operates Canberra E 15s and T 17s from Cottesmore on high altitude radio and radar calibration duties, and its sister unit, No 115 Sqdn, with nine converted Argosy E 1 transports and responsibility for the low-level checking of ground aids from the same base. These two units undertake the calibration and checking of ILS facilities, precision approach radars, non-directional beacons, Eureka distance measuring equipment, TACAN, surveillance radars and cathode-ray direction-finding equipment at more than 200 RAF, Royal Navy and Ministry of Defence airfields throughout the world. Cottesmore is also the home of the Canberra OCU (No 231), now much reduced in size and commitments since its move from its base of more than 20 years at Bassingbourne.



14 Ajax feel unit (pitch control)
15 Nosewheel well
16 Instrument panel
17 Projected map display (head-down)
18 Windscreen
19 Head-up display panel
20 Plexiglass canopy
21 Martin Baker Mk 9 ejector seat
22 Honeycomb cockpit side panels
23 Instrument console
24 Access panels
25 Cannon barrel
26 Battery and electrics bay
27 Intake
28 Spring-loaded supplementary-air doors
29 30-mm Aden cannon
30 Main undercarriage side door
31 Undercarriage retraction jack
32 Integrally-stiffened frame
33 Ammunition trough
34 Intake bolt-up joints
35 Intake duct frames
36 Intake/fuselage attachment plate
37 Cold-air unit
38 Ram-air intake
39 Twin VHF homer aerials
40 Inner dorsal spine (hydraulic and cable runs)
41 Slat motor and gearbox
42 264 Imp gallon (1,200-l) auxiliary fuel tank
43 Starboard inner pylon
44 1,000-lb (472-kg) bomb
45 Starboard outer stores pylon
46 Leading-edge steel slat-rail
47 Starboard navigation light
48 Honeycomb-filled spoiler
49 Wing fence
50 Pylon mount
51 Fuel lines
52 Wing construction
53 Starboard wing integral fuel tank
54 Dorsal anti-collision beacon
55 Control rods
56 Wing centre-joint
57 Forward wing-fixing joint
58 Box-section centre-keel
59 Ram-air intake
60 Honeycomb-filled flap
61 Primary heat-exchanger
62 Upper fuselage access panels
63 Engine forward mounting point
64 Accumulator No 2 system
65 Hydraulic system pressure reservoir No 2
66 Air extractor duct
67 Upper fuselage access panels
68 Inward/outward vent valve
69 Starboard/tailplane
70 Tailfin construction
71 Magnetic detector
72 Tailfin leading-edge
73 Sensor fairing
74 VHF/UHF antenna in fin tip
76 Rear navigation light
77 HF antenna
78 Honeycomb-filled rudder section
79 Fuel dump vent
80 Landing parachute housing
81 Rudder power control unit
82 Control run linkage
83 Tailplane control units
84 Tailplane pivot point
85 Tailplane construction
86 Tailplane longitudinal stability discontinuity
87 Honeycomb-filled outer section
88 Arrester hook (extended)
89 Shroud-ring nozzle flaps
90 Afterburner
91 Aft fuselage integral fuel tanks
92 Engine aft mounting point
93 Rolls-Royce/Turboméca Adour 102 engine
94 Centre fuselage section
95 Air brake actuator
96 Air brake (extended)
97 Wing fence
98 Pylon mount
99 Full-span trailing-edge double-slotted flaps
100 Port navigation light
101 1,000-lb (472-kg) bomb
102 Port outer stores pylon
103 Leading-edge slat
104 Port inner stores pylon
105 264 Imp gallon (1,200-l) auxiliary fuel tank
106 Low-pressure twin mainwheels
107 Shock-absorber strut
108 Mainwheel leg
109 Drag strut
110 Undercarriage flap
111 Centre-line ventral stores pylon (shown lowered)
112 Tandem-mounted BL 755 cluster bombs
113 Cannon port
114 Nosewheel
115 Single (starboard) axle fork
116 Nosewheel leg
117 Two landing lights (one 450W, one 250W)
118 Nosewheel door
119 Anti-shimmy gear
120 Towing lug

Completing the combat equipment of 1 Group is the Buccaneer Wing at Honington, now comprising No 12 and the recently-formed No 208 Sqdn, each operating about 14 S 2A and S 2B aircraft, plus a similar number in No 237 (Buccaneer) OCU. The MARTEL air-to-surface missile-equipped Buccaneer S 2Bs of No 12 Sqdn are tasked with operating in support of naval forces as part of Strike Command's commitments to the Supreme Allied Commander Atlantic (SACLANT) of NATO. A third UK-based Buccaneer squadron is expected to be formed this year with the remainder of the batch of 26 S Mk 2Bs ordered in 1971, and will increase the total land-based strike force to more than 100 of these aircraft, including 60 or more taken over from the Royal Navy. No 12 Sqdn, however, will remain the sole unit with a

(Above) As SEPECAT Jaguars are introduced in the close support rôle, they are releasing McDonnell Douglas Phantom FGR Mk 2s for air defence, in turn replacing Lightnings. Illustrated above are Phantoms of the first interceptor unit, No 111 Squadron. Immediately below, a Lightning F Mk 2A of No 19 Squadron, based at Gutersloh as part of the RAF force in Germany. Bottom, a Jaguar of No 54 Squadron, first RAF unit to fly this new type

primarily maritime rôle until the RN Buccaneer squadron now operating from HMS *Ark Royal* is transferred to the RAF when the carrier is withdrawn from service in the late 1970s. Strike Command, with RAF Germany, will also provide Buccaneers allocated to SACEUR for overland strike/attack and reconnaissance.

These rôles are scheduled to be the first taken over by the Panavia MRCA, of which the first of 385 required by the RAF are due to begin replacing Vulcans, Canberras and Buccaneers from 1977–78 onwards in No 1 Group. About 220 of the RAF MRCAs will be allocated to strike/recce/interdiction rôles, although it has been officially stated that some two-thirds of the "fighting front line" will be composed of this single basic aircraft by the 1980s. This indicates a total RAF combat inventory by that time of about 580 aircraft. Because of its importance, the MRCA has so far been spared the axe of defence economies, although in the recent review it was announced that the delivery rate to the RAF will be reduced by up to one-third to spread the costs of the programme, currently estimated in Germany at DM2,826m (£507m) for development, and DM1,609m (£289m) to launch production. Unit cost estimate for the RAF Panavia MRCAs was recently quoted in Parliament as £3·9m at 1973 prices, although this will inevitably be increased by the proposed stretch-out in production.

Introduction of the MRCA will do much to help reduce the multiplicity of types currently operated by the RAF, and its short-field capabilities will aid its survivability by freeing it from the long runways of targeted bases. The strike version will also offer a very advanced all-weather weappn delivery system of great accuracy for a wide range of stores, with ultra-low-level automatic terrain-following.

The Air Defence Scene

No 11 Group, from its Headquarters at Bentley Priory, near London, continues the former Fighter Command responsibilities of providing early warning of aircraft and missile threats to the UK, investigating violations of national air space and meeting all air defence tasks within the UK Air Defence Region. The UK ADR, contained entirely within NATO Early Warning Area 12, forms part of a unified air defence system under SACEUR, which extends to cover three other NATO air defence regions. Following the 1967 change in NATO strategy away from massive nuclear retaliation and the increasing emphasis on the possibility of Soviet low-level attacks with manned aircraft, the UK air defence system had to be re-orientated from its mainly south-eastward facing deployment to cover approaches from all directions, and especially the north. Additional radar ground stations had to be installed to provide the necessary extra coverage, and the original Linesman/Mediator scheme of the all-nuclear era decentralised.

In place of the earlier Master Radar Stations, the new ADR organisation now comprises three key sector operations centres (SOCs) with control and reporting facilities, grouped around radar units at Buchan, Boulmer and Neatishead, on the east coast of Britain. These are fed with information from six NATO Air Defence Ground Environment (NADGE) stations via digital link with the Air Defence Data Centre at West Drayton and the Air Defence Operations Centre at Strike Command HQ, High Wycombe. Data is also fed into the system from the recently inaugurated control and reporting post on Benbecula and from the reporting site at Saxa Vord. There are additional links with the Ballistic Missile Early Warning System (BMEWS) station at Fylingdale.

(Above) Hawker Siddeley Vulcan B Mk 2s will continue to serve with Strike Command until eventually replaced by the Panavia MRCA (illustrated on pp 2-3). (Below) As a result of the recent defence cuts, the RAF force of Lockheed Hercules C Mk 1 tactical transports is being reduced from 61 to 48 aircraft

Further and essential long-range low-level radar coverage has been provided by the introduction of a single squadron of 12 Shackleton AEW Mk 2 airborne early-warning aircraft, adapted from their former maritime reconnaissance rôle by the installation of the well-tried AN/APS-20(F)I radar of the type fitted to the RN's Gannet AEW Mk 3, plus ESM, IFF and Doppler navigational equipment. Despite their age and small numbers, the Shackleton AEW Mk 2s of No 8 Sqdn have proved invaluable in aiding interceptions of low-flying Soviet aircraft at distances up to 1,200 miles (1 930 km) from the UK by 11 Group's all-weather force of interceptors in seven squadrons, supported by the tanker fleet of No 1 Group.

The long-standing RAF requirement for an *ad hoc* replacement of its interim Shackleton AEW 2s remains unchanged, and includes as much overland capability as possible in addition to the primary over-water rôle. A high transit speed is also regarded as essential, and although development is continuing of such indigenous radar systems as the Marconi Space & Defence FMICW (frequency modulated intermittent continuous wave) equipment for a proposed AEW version of the Nimrod, current Ministry of Defence interest appears to be turning towards American proposals for a unified force of Boeing E-3A AWACS aircraft within NATO. This would involve the operation from Europe of up to 32 Boeing E-3As by the NATO countries concerned, although the AWACS (airborne

Two squadrons of Hawker Siddeley Bucanneers are currently attached to the 2nd Tactical Air Force in Germany, including No 15, one of whose S Mk 2B aircraft is illustrated

warning and control system) aircraft would be assets of the western alliance rather than the property of individual nations. The US is prepared to bear about 25% of the cost of the proposed NATO AWACS fleet, with the other members sharing the balance.

As currently organised, 11 Group's interceptor force of seven squadrons is well advanced in converting from the time-honoured BAC Lightning, of which nearly 100 F Mk 3s and 6s until recently equipped five home-based squadrons plus an OCU, to the McDonnell Douglas F-4M Phantom FGR Mk 2, and this process is scheduled for completion by the end of this year. The Phantoms are being released from RAF ground attack units as the latter are progressively re-equipped with Jaguars, and for the air defence rôle are being armed with AIM-7E2 Sparrow air-to-air missiles as well as AIM-9D Sidewinder AAMs. Some RAF Phantoms will also carry pod-mounted M61 multi-barrelled cannon for interception duties, supplemented at a later stage by the XJ 521 version of the Sparrow AAM, for which Marconi and EMI Electronics are developing an advanced semi-active homing head and a new fuze system. In the absence of a development go-ahead for the HSD SRAAM, a new short-range dogfighting missile is also likely to be sought over the long term, with a final choice probably being made between the US AIM-9L Super Sidewinder and the MATRA 550 Magic.

Strike Command's first interceptor unit to operate the Phantom FGR 2 – No 111 Sqdn – formed at Coningsby in July 1974 with the F-4Ms formerly operated by No 54 Sqdn, and before its predecessor Lightning unit disbanded at Wattisham. It was followed by the second Wattisham Lightning unit, No 29 Sqdn, now operating Phantoms at Coningsby alongside No 228 (Phantom) OCU, and will presumably be joined this year by No 56 Sqdn, which recently withdrew its Lightnings from Cyprus and seems likely to change them for Phantoms. The remaining Phantom Squadron – No 43 – is the sole RAF unit to operate the F-4K or FG Mk 1 version, from 20 aircraft taken over from the Royal Navy.

The main Strike Command Lightning force is now based at Binbrook, Lincs, which houses the F Mk 3s and 6s of Nos 5 and 11 Sqdns, as well as the six Lightning 3s and T 5s of the abbreviated conversion unit, following the closure of No 226 OCU last year. The fourth UK-based Lightning unit is No 23, at Leuchars, which may also re-equip with Phantoms this year, leaving the Binbrook Lightning Wing to continue operating F Mk 6s until at least the end of this decade. In the meantime, the RAF Phantom force (originally comprising 20 Spey-powered F-4Ks and 118 F-4Ms) is being modified by Hawker Siddeley at Brough by the addition of wing stiffeners, re-skinned stabilators and bolt replacements to extend its fatigue life into the 1980s, when the interceptor version of the MRCA is scheduled to re-equip the air defence units.

Continued development of this MRCA interceptor, which will have an advanced AI radar and fire-control system in a 15-in (38-cm) longer nose in place of the TFR and attack avionics of the strike version, was confirmed in the recent defence review. About 165 aircraft will be required by the RAF, which plans to introduce its first MRCA interceptors into service by 1981–82. The avionics for this version have reached the project definition stage and will probably be supplied by British industry. Up to nine interceptor squadrons, including two in Germany, will probably re-equip with the air superiority version of the MRCA, plus an OCU with several dual-control trainers. The latter aircraft will retain operational capability, as do the Harrier and Jaguar two-seaters, and all the current OCUs have shadow rôles (and squadron numbers) as additional combat units.

To supplement its manned air defence force, the RAF still operates a couple of squadrons of BACGW Bloodhound Mk 2 surface-to-air missiles controlled in the UK by No 38 Group, as well as about a dozen SAM and AA gun units of the RAF Regiment, and also equipped with Short Tigercats and BACGW Rapiers in the UK, Germany and the Near East. The low-level air defence squadrons in Strike Command are available for detachment as required; units have recently been serving in Northern Ireland, Oman, Hong Kong and Belize. The Rapier system will soon be given a blind-fire capability for night and poor-weather operation by the addition of the Marconi Space and Defence Systems DN 181 tracking radar, now nearing its final stages of development.

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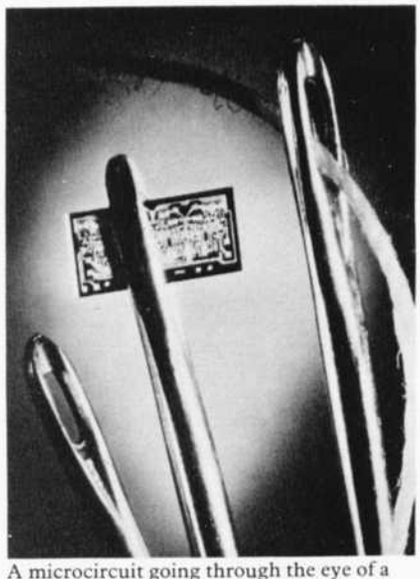

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Target facilities for No 11 Group are provided by three Canberra squadrons (Nos 7, 85, 100), each with a dozen or more B Mk 2, T Mk 4s, TT Mk 18s and T Mk 19s, operating from St Mawgan and West Raynham. With the other UK and NEAF units, these bring the total number of Canberra squadrons in current RAF service to seven, plus an OCU. No 11 Group also controls the Hunter OCU, with three back-up squadrons (63, 79, 234) totalling 48 aircraft at Brawdy. This unit operates the last Meteor F Mk 8 in RAF service on target-towing duties.

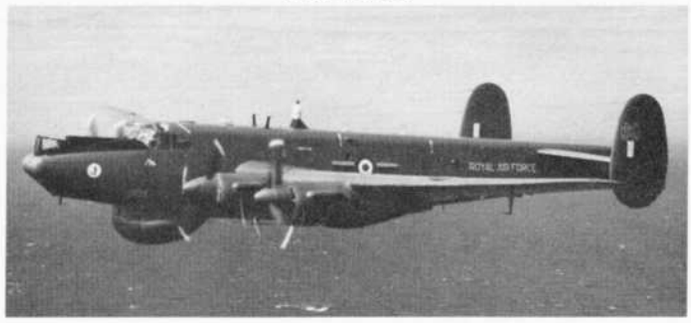
Maritime and Tactical Elements

As the former Coastal Command, No 18 (Maritime) Group, with HQ at Northwood, Middlesex, maintains strong NATO affiliations, and its C-in-C holds the joint posts of Commander Maritime Air Eastern Atlantic and Commander Maritime Air Channel Command. Main air tasks of the Commands in war would be reconnaissance, support of the Atlantic Striking Fleet; control, routeing and protection of shipping, and offensive operations against enemy submarines, in addition to the normal peace-time rôles of ocean surveillance and SAR.

With four squadrons (Nos 42, 120, 201, 206) at two UK bases, plus an OCU (No 236), operating most of the initial batch of 38 Hawker Siddeley Nimrod MR Mk 1s, Strike Command can claim to be equipped with the most advanced anti-submarine aircraft in world-wide service and a further eight are being completed to meet a pre-defence review RAF requirement. Since eight Nimrods will become redundant in 1979 with the planned withdrawal and disbandment of the RAF's fifth Nimrod squadron – No 203 – from Malta, the future of these 16 apparently surplus aircraft is uncertain. A further reduction in the RAF MR commitment will result from the withdrawal, by April 1976, of the detachment of four Nimrods maintained hitherto in Singapore under the Five Power Defence Agreement, but the Government recently announced that four aircraft of a so-far unspecified type will be made available for the protection of Britain's expanding off-shore oil and gas installations in the North Sea. Several Buccaneers will also be made available for routine patrols over the North Sea oil and gas areas, flying as much as 45 hours per week, from 1977 onwards.

Despite the defence economies, the up-dating programme for the Nimrod's avionics systems to Mk 2 standards is continuing, and contracts have been placed with several British companies for improvements to its radar, sonar, nav/attack and communications equipment. Principal change in the phase 2 Nimrod will be replacement of its ASV-21 main surveillance radar by the new EMI Searchwater long-range detection equipment, in conjunction with FM1600D computers supplied by Ferranti Digital Systems.

Range deficiencies of No 18 Group's two Whirlwind helicopter squadrons (Nos 22 and 202), operating in nine detached flights which are limited to an 80-mile (130-km) radius of action, have resulted in their initial supplementation by twin-turbine Wessex HC 2s from No 72 Sqdn. The long-standing requirement for a number of RAF Sea Kings for SAR is still under consideration;

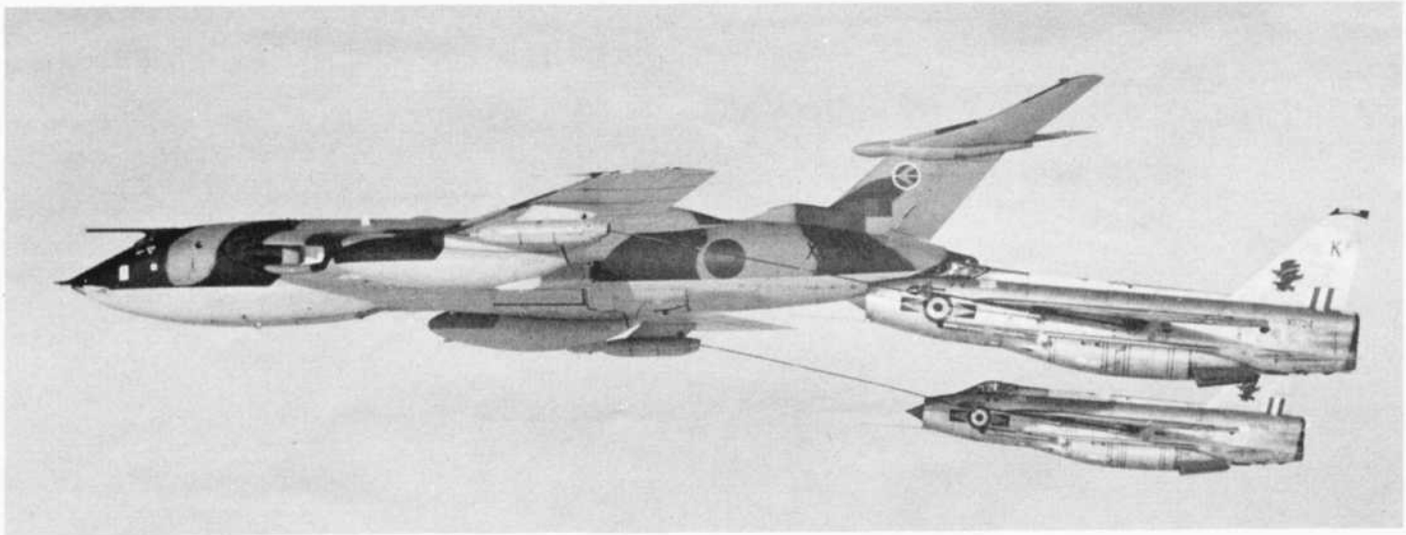


(Above) A new RAF commitment is to carry out routine surveillance of offshore waters and oil-drilling operations. Both Hawker Siddeley Nimrods (illustrated, over a North Sea oil rig) and Vulcans fly regular patrols. (Below) the only RAF unit dedicated to airborne early warning is No 8, with Shackleton AEW Mk 2s

until it is fulfilled, some Nimrods must continue to remain on stand-by for long-range search and rescue duties.

As a self-contained air force, Strike Command has its own tactical element to provide offensive support for forces in the field, battlefield reconnaissance and logistic support, all of which are the responsibilities of No 38 Group. The tactical strike component of 38 Group currently comprises seven squadrons, including the first in the RAF to re-equip with the V/STOL Harrier (No 1) at Wittering, which also houses the Harrier OCU (No 233). Until recently, the main strike element of No 38 Group comprised two squadrons (Nos 6 and 41) each operating 10–12 Phantom FGR 2s on strike and reconnaissance duties from Coningsby, but in 1974 No 38 Group became the first RAF Jaguar operator. An additional squadron – No 54 – was re-formed as the first of three Jaguar GR 1 units planned for the Group, and has since been joined at

The RAF's tanker force is currently being modernised with the introduction of Handley Page Victor K Mk 2 tankers, modified from the original bomber rôle by Hawker Siddeley. Illustrated is a Victor from No 232 OCU, with two Lightnings of No 11 Squadron



Coltishall by No 6 Sqdn after its re-equipment. By the end of 1975, these two units will each comprise 12 Jaguar GR 1s, one Jaguar T 2 trainer and 16 pilots, and will be joined by No 41 Sqdn after its re-equipment from Phantoms.

Main rôle of No 41 Sqdn will be tactical reconnaissance, and for those Jaguar units required to have this capability, the MoD has ordered 45 sets of Type 401 Linescan infra-red surveillance equipment from HSD for installation in standard external pods. The RAF is now committed to a total of 202 Jaguars, comprising 165 GR Mk 1s for the three UK and five German-based Jaguar squadrons scheduled, and 37 T Mk 2 trainers for these units and the Lossiemouth OCU (No 226). Both Jaguars and Harriers are now being fitted with nose-mounted laser-designator rangefinders for improved weapons delivery accuracy, and ground forces are receiving complementary illuminators. No 38 Group's tactical strike element is completed by two squadrons of Hunter FGA 9s – Nos 45 and 58 – at Wittering, which were re-formed in 1972 to provide additional offensive capability and develop a pool of experienced ground attack pilots.

All 38 Group's tactical units are organised for maximum mobility, to move anywhere at short notice and fulfil their rôle of reinforcement. For forward troop lift, 38 Group has three squadrons of assault and transport helicopters, comprising No 72 Sqdn, with about 20 Wessex HC Mk 2s, and Nos 33 and 230 Sqdns, each with around 12 of the 40 SA 330 Puma HC Mk 1s ordered from joint Aérospatiale and Westland production. These squadrons operate from Odiham, which also houses the Puma and Wessex OCU. No replacement is now foreseen for the Wessex before the 1980s, and the long-standing requirement for a medium-lift helicopter (MLH) for army and Harrier support was finally killed in the recent Defence White Paper.

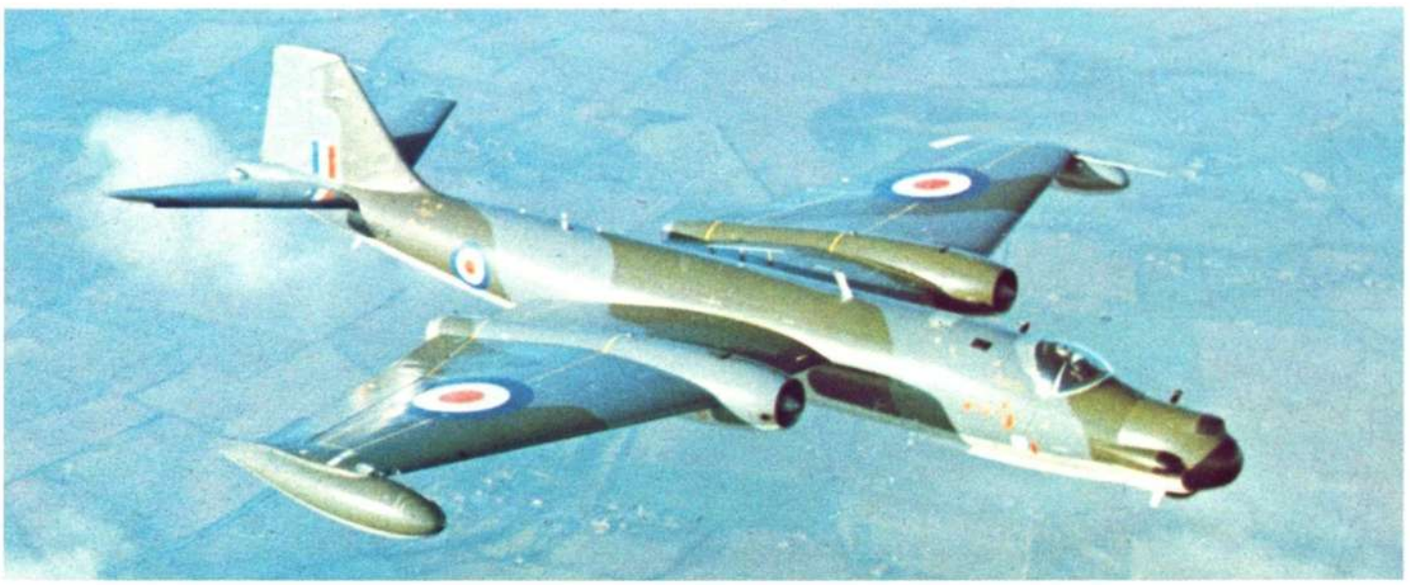
(Above) The RAF has obtained about a dozen Aérospatiale-Westland Gazelles to train its helicopter instructors

Transport Cut-Backs

As the RAF element most affected by the defence economies, the transport force, represented by No 46 Group, is to be effectively halved by the recent Government decisions, including the abandonment of most of its remaining overseas commitments outside Europe. Prior to the Defence White Paper, No 46 Group operated a total of 127 fixed-wing transports to provide airlift facilities for the deployment of UK forces to their war and contingency locations and tactical support for those forces in the field. These were organised in two elements – strategic and tactical – controlled from Group HQ at Upavon. The strategic force mostly comprised adapted civil transports, including 22 Britannia C Mk 1s and 2s in Nos 99 and 511 Sqdns, 13 VC10 C Mk 1s in No 10 Sqdn and five Comet C Mk 4Cs of No 216 Sqdn, although 10 of the specially-built and massive Short Belfast C Mk 1 freighters of No 53 Sqdn have also been operating from the long-range terminal at Brize Norton for particularly bulky loads. The converted civil types will bear the brunt of the defence economies, and the Britannia and Comet units will be disbanded before the end of 1975. Their aircraft will be offered for sale to potential civil customers or, more probably, scrapped. No 10 Sqdn is to lose four of its VC10s, although two of these will be kept in reserve; the remaining two will probably find civil customers. The Belfasts are to remain in service within the foreseeable future.

No 46 Group's "stractical" element of C-130K Hercules C Mk 1 units, boosted to six squadrons (Nos 24, 30, 36, 47, 48, 70) by the withdrawal from Cyprus, and now operating from Lyneham, is also to be cut back by more than 20 per cent. Of the 61 C-130Ks remaining in the RAF inventory (from 66 originally procured), 13 are to be withdrawn – probably from No 70 Sqdn – and stored in reserve, leaving 48 in service. These are currently undergoing a refurbishing programme to extend their fatigue lives, and are expected to remain in RAF service until at least the mid-1980s.

(Above left) A BAC Canberra T Mk 4 from No 231 OCU and (below) a Canberra T Mk 17 from No 360 Squadron. Well over 50 Canberras of assorted marks still serve in the RAF, in some cases being flown by pilots younger than the airframes themselves



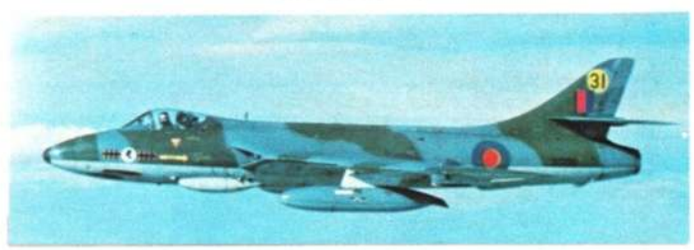
The Hawker Siddeley Hawk T Mk 1 is now being prepared for RAF service, which it will enter during 1976. Initially it will replace the Gnat advanced trainer and the Hunter weapons trainer, later taking over some of the training rôles of the Provost basic trainer also

Their commitment for airlift support of the UK element of ACE (Allied Command Europe) Mobile Force, which includes 12 Harriers and four Wessex helicopters, remains unchanged, but they will no longer be required for the UK Joint Airborne Task Force (JATFOR), which was axed by the recent Defence White Paper.

For shorter-range tactical transport, 46 Group had a single squadron (No 46) of Hawker Siddeley Andover C Mk 1s, which also served on detachment in the Persian Gulf. This squadron is being disbanded following the defence review, and a total of 17 Andovers is being withdrawn from service, thus reducing the RAF fixed-wing transport fleet to a total of 67 – 48 Hercules, 10 Belfasts and nine VC10s – plus 13 Hercules and two VC10s in reserve. Two or three Andover CC Mk 2s, basically similar to the civil HS 748, will presumably continue to operate with the Queen's Flight from Benson, alongside two Wessex HCC Mk 4 helicopters within 46 Group. One or two Andovers, together with other light transports, including 14 BAC Pembroke C Mk 1s, a few Devons, Whirlwind helicopters and four HS 125-400s and two -600 "executive" jets are operated by four regional communications squadrons (Nos 21, 26, 32, 207) in the UK, plus one in Germany (No 60).

The RAF Overseas

As the RAF's remaining combat element permanently based overseas, the operational component of RAF Germany forms a major part of NATO's 2nd Tactical Air Force (whose HQ is at Rheindahlen) which, together with Belgian, Dutch and West German forces, supports the Northern Allied Army Group. Recently, Air Forces Central Europe (HQ AAFCE) has been set up under CINCCENT to co-ordinate activities of both 2nd ATAF and NATO's other tactical force in the Central region, 4th ATAF. NATO and national rôles of HQ RAF Germany have remained unchanged, however, and include the provision of nuclear and conventional strike, reconnaissance, offensive support and air defence, for which the Command now has a tactical force of 11 combat squadrons, including three with Harriers (Nos 3, 4, 20) at Wildenrath; four with Phantom FGR Mk 2s (Nos 14, 17 and 31 at Brüggen and No 2, with a unique tactical-recce rôle at Laarbruch); two (Nos 19 and 92) with Lightning F Mk 2A interceptors at Gutersloh, east of the Rhine; and two (Nos 15 and 16) with Buccaneers at Laarbruch.



(Above) A BAC Jet Provost T Mk 3 of No 1 FTS and (below) a Hawker Hunter FGA Mk 9 of No 234 Squadron, part of No 229 OCU at Brawdy

The Harrier force in Germany is committed to tactical-recce and close support of NATO forces in Europe, and its 36 V/STOL fighters are dispersed among 30 or more off-airfield sites for training. The Harriers are supported by elements of No 18 Sqdn, which operates 15 Wessex HC Mk 2 helicopters from Wildenrath. The 15 or so Harriers ordered in 1973 as a follow-on to the initial 77 GR Mk 1s and 13 T Mk 2 two-seat trainers will enable the RAF to maintain its front-line strength of four V/STOL fighter squadrons while allowing aircraft already in service to be withdrawn for improvements. These include the retrofitting, now well under way, of the up-rated Pegasus 11, which will extend the life of the Harrier, in its GR Mk 3 and T Mk 4 forms, into the 1980s. An Operational Requirement for a Harrier/Jaguar successor is nearing

The Hawker Siddeley Harrier gives the RAF a unique capability to operate from dispersed sites with no runways; these Harrier GR Mk 3s serve with No 3 Squadron at Wildenrath in Germany

finalisation, and current indications are that it will not incorporate V/STOL capability.

One of the biggest changes in HQ RAF Germany over the next year or so will be the introduction of the Jaguar, to re-equip the Phantom squadrons and so free their aircraft for the intercept rôle. All four Phantom squadrons in Germany – Nos 2, 14, 17 and 31 – are scheduled to receive Jaguars during the next two years, towards the scheduled build-up of five Jaguar units within RAF Germany. The main Jaguar base in Germany will be Brüggen, where No 14 Sqdn is now in the process of formation. It will be the first RAF Jaguar squadron to be given a nuclear rôle within NATO. The RAF will eventually have 10 Jaguar squadrons, including two within the OCU, or three more than originally planned. Some Phantoms will remain in Germany to re-equip Nos 19 and 92 Sqdns over the next two years. The RAF Germany will also have four squadrons of the RAF Regiment with Rapier SAMs by the end of 1975, for airfield defence, in place of its existing units armed with the 40-mm Bofors L40/L70 AA gun.

Prior to the defence review, the remaining overseas command was Near East Air Force, which has its HQ in the Sovereign Base Area of Episkopi, Cyprus, but is now in the process of running down. At the moment, it still controls units in Malta, Gibraltar, Masirah (off Southern Arabia), Salalah in Oman and the island of Gan, and has certain responsibilities for the RAF in Singapore and Hong Kong. It also had the tasks of supporting the Central Treaty Organisation (CENTO), and the southern flank of NATO from Malta. Britain no longer declares any forces to the CENTO Organisation, however, and the RAF units in Malta are to be withdrawn by 1979. The Canberra PR Mk 7s and 9s of No 13 Sqdn will return from Luqa to a UK base, while No 203 Sqdn, currently operating Nimrods from the same airfield, will disband. Strike Command aircraft will still operate from Cyprus on detachment, where No 84 Sqdn will continue to operate a flight of Whirlwind 10 helicopters for the UN Force in Cyprus (UNFICYP) from Nicosia.

The only remaining RAF units permanently based overseas are two other helicopter squadrons, both equipped with Wessex HC Mk 2s. No 28 Sqdn, operating from Kai Tak, Hong Kong, is unaffected by the defence review, but No 103 Sqdn at Tengah, Singapore, is to be disbanded.

Training Command

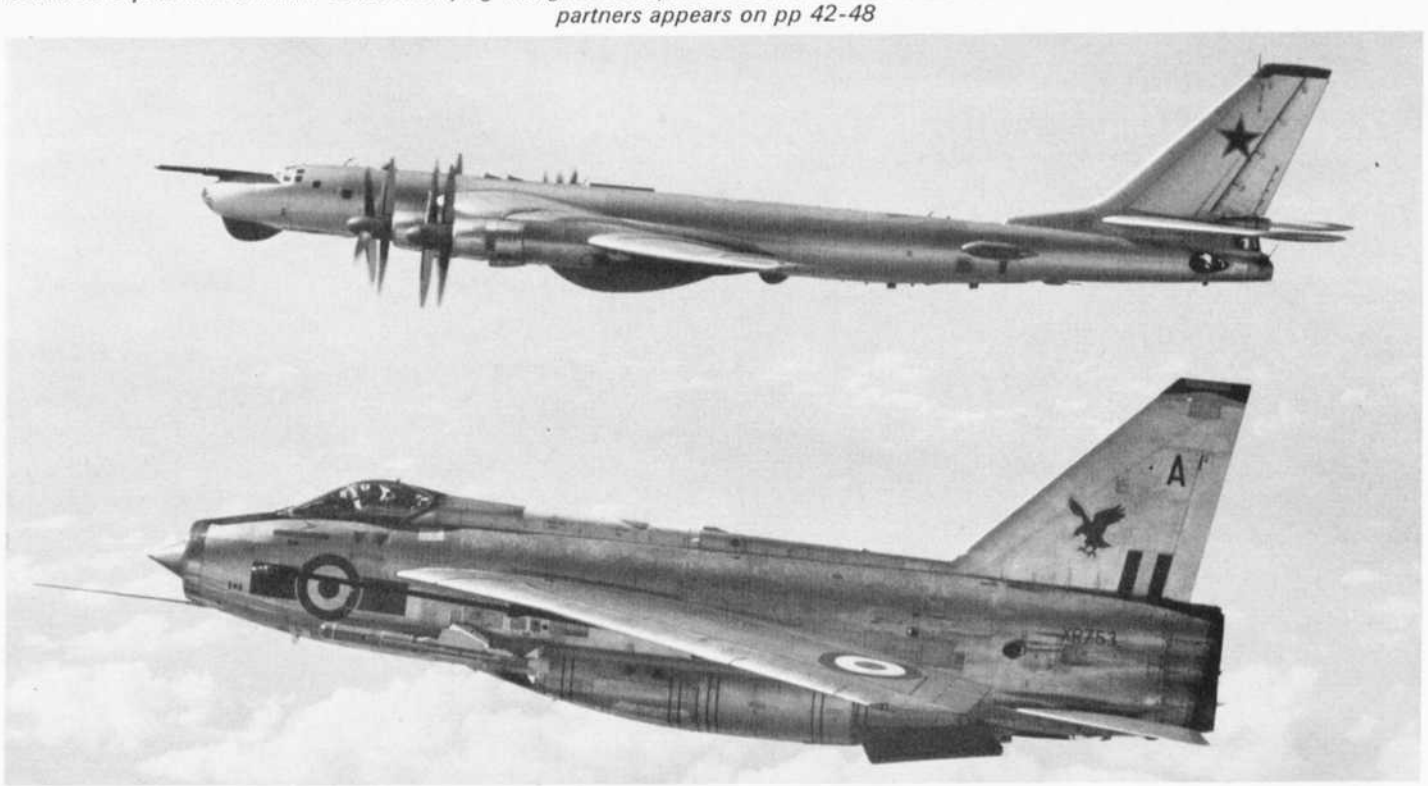
Some of the biggest recent changes in RAF organisation and operations have taken place within Training Command, which has about 450 aircraft on establishment and also controls about 250 Slingsby T-21, T-31 and other gliders used by the Air Training Corps and RAFGSA units. The Command was formed in 1968 by the amalgamation of Technical and Flying Training Commands, and now has only one Group – No 23 – with HQ at Linton-on-Ouse. This is responsible for all basic and advanced training of direct entrant pilots and other aircrew, while ground instruction is now controlled directly by HQ Training Command.

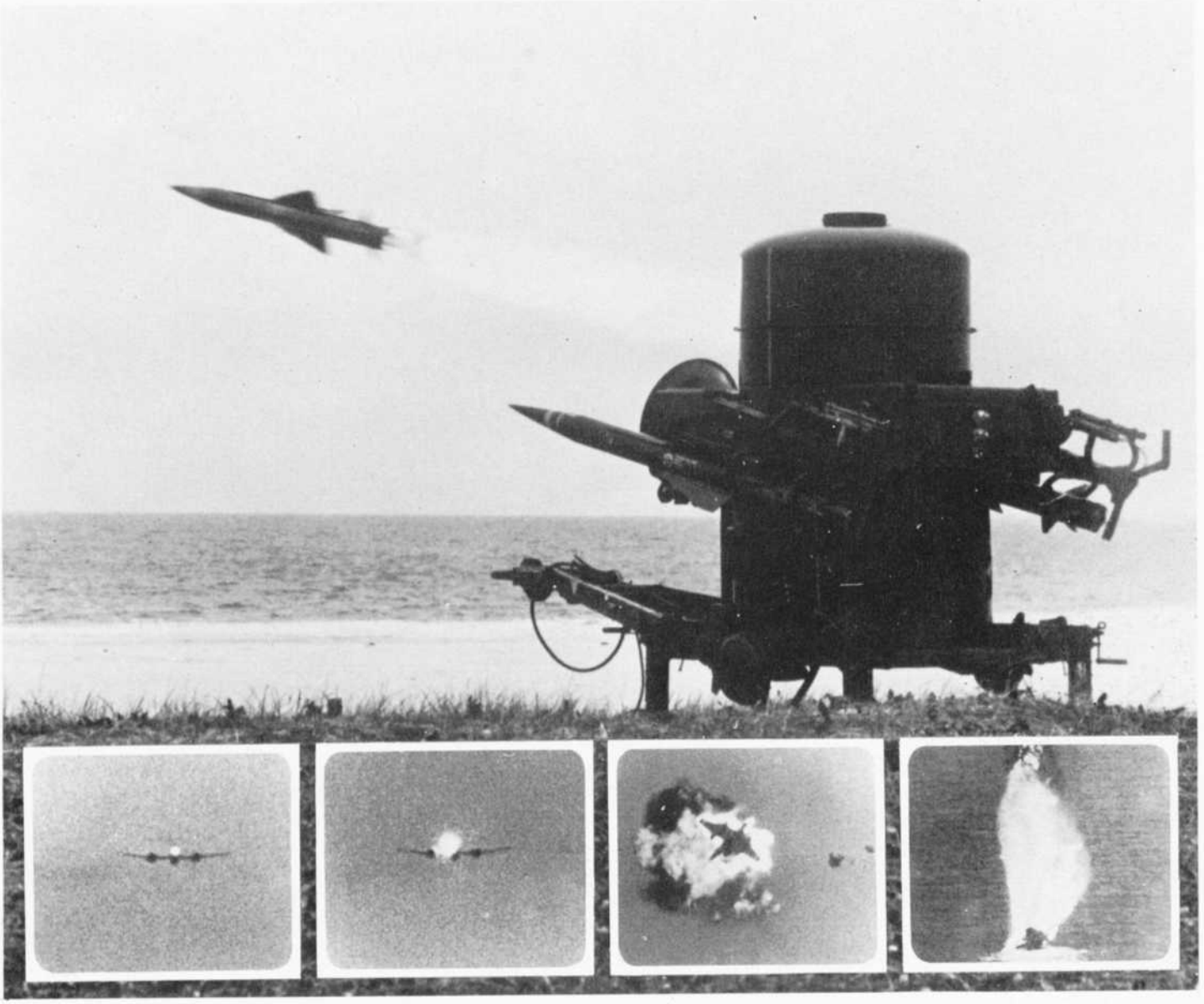
A new pattern of pilot training was introduced in October 1974 to reduce training time without lowering standards, while offering more economy and making use of fewer stations. In 1968, some 34 RAF stations were utilised for training duties and this number has since been reduced by about 10. By 1977, the number of RAF training bases will be down to 15, most of the remainder having been closed. Future RAF pilot requirements will be reduced to about 160–185 per year as a result of the defence review, compared with about 300 some four years ago. To achieve any of these totals requires considerably higher numbers of applicants since there is about 50 per cent wastage in the selection process and a further 45 per cent or so attrition in the course of training.

Among the many changes which the RAF has experienced during recent years is the emphasis on University graduates for its aircrew candidates, and these now comprise about 50 per cent of the total pilot intake. This has been effected by building up the

continued on page 38

Interception and investigation of Soviet aircraft flying over the North Sea is a regular RAF activity. This illustration shows a Lightning of No 23 Squadron from RAF Leuchars flying alongside a Tupolev "Bear". An article about the Soviet Air Force and its Warsaw Pact partners appears on pp 42-48





Rapier – now in service in Britain and abroad – has revolutionised defence against low-flying attackers

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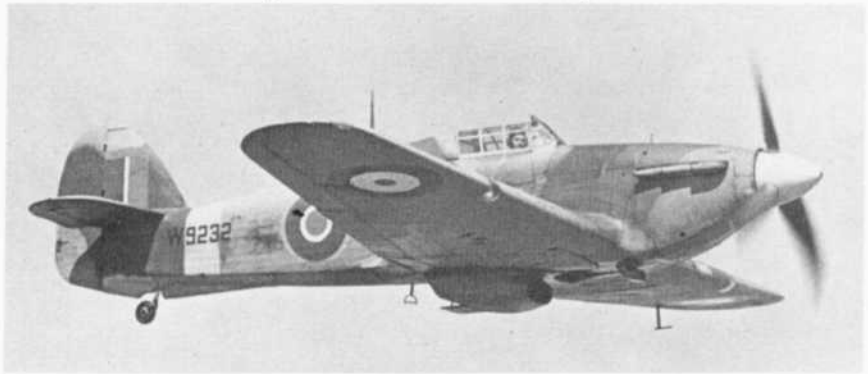

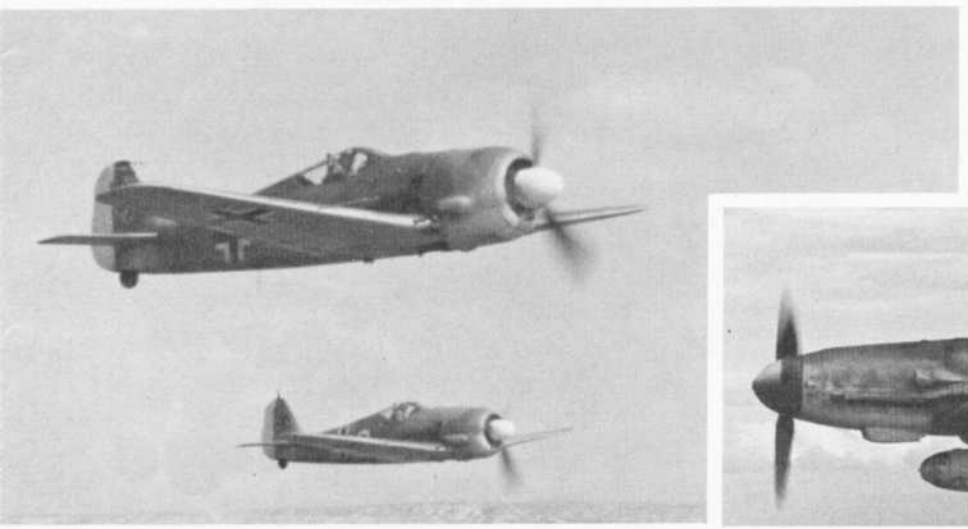

FOUR OF THE FINEST

The Spitfire, Hurricane, Messerschmitt 109 and Focke-Wulf 190 – the mounts of most of the greatest fighting pilots of the RAF and Luftwaffe in World War II. Here their characteristics are described by two pilots whose wartime tasks embraced test-flying them rather than taking them into combat, thus permitting objective rather than emotive assessments of their qualities and shortcomings. H A 'Tony' Taylor describes the British fighters and Captain Eric Brown their German counterparts

THE REAL MERITS of the popularly best-known British fighting aeroplanes of World War Two, the Supermarine Spitfire and the Hawker Hurricane, are demonstrated not by the traditional story of the vital part they played in the desperate days of 1940, but by the fact of their continued and successful development afterwards. Only very good designs could have survived the metamorphoses needed to keep them in active service for five more years of war. More extraordinary still was the fact that, despite the considerable changes made, they retained the best of their original handling characteristics.

Personal confirmation of this cannot be given for the Hurricane because I ferried and tested succeeding variants from the Mk I to the Mk IIC more or less continuously between 1939 and the end of 1942 and therefore "grew up" with them, finding little change as the type developed. In the case of the Spitfire, however, I made a few delivery trips with Mk Is early in 1940, and then flew none until the summer of 1944, when I was posted to a maintenance unit (MU) which specialized in work on this fighter. There, the developed Mk IXs seemed familiar enough after the long time-gap, and even the monstrous-looking Mk XIVs were still manifestly Spitfires, even though, with Griffon engines in place of Merlins, they were much more massive affairs.

Needless to say, these two fighters, in their many versions, were not the entirely perfect devices which mythology has sometimes made them out to be, but most faults were usually ironed-out by the manufacturers' test pilots, or those of the Aeroplane & Armament Experimental Establishment. Spitfires, for instance, sometimes suffered from lateral-control variations and defects which could not be cured by adjustments to the ailerons; there were occasional "rogue" cases where pairs of ailerons and even wings had to be changed.

Later marks of Hurricane and some intermediate Spitfire variants tried to 'take charge', in steep turns or during recovery from dives, by "tightening-up", so that hard forward pressure had to be applied to the control column to prevent dangerous over-loading. This tendency could be held fairly easily and instinctively in the case of the Hurricane IIs, but there were reports of wing failures with Spitfires, and ingenious temporary action was taken. A weight was introduced into the elevator circuit in such a way that, when the turn or pull-out started to "tighten" and loading to increase, the inertia of this weight applied a nose-down pressure to the elevator control. Operational pilots did not much like this interference with their prerogative, but, as it happened, a simpler solution to the problem was soon found – that of increasing slightly the aerodynamic balance of the elevator.

Each of these two fighters had, in a remarkable way, either handling characteristics to compensate for mildly disadvantageous design features, or design features to compensate for any handling deficiencies. The Spitfire gave the erroneous impression of being a delicate creature on its narrow-track outward-retracting undercarriage, but the control at low speeds was so positive that landing stresses could be minimal. Arrivals on out-of-wind runways were

trouble-free because compensating "drift" could be held accurately to touchdown. The Hurricane had less positive control at low speeds and a somewhat sharper stall – but the wide-track inward-retracting undercarriage provided compensation. We put them down on rough satellite fields which would not normally have been considered for Spitfires – which, on the other hand, we happily flew on and off snow-covered out-of-wind runways.

The Hurricane had large-area flaps to provide the amount of "drag" which simplified an approach to small fields and, even with some power on, steepened the glide sufficiently to give the pilot a good view over the nose. The Spitfire had small-area flaps and a nose-high approach attitude, but the good low-speed handling allowed one to arrive in a gentle turn so that the runway could be kept in view until the final straighten-out and landing. Those small up-or-down-only flaps, operated pneumatically by means of a little control on the dashboard, remained a feature of the Spitfire throughout its score and more of variants. They suited the Spitfire, but would never have suited the Hurricane.

Another divergence in design was in the fuel-tank arrangement. The Hurricane had its main tanks in the wing centre-section, with a small-capacity tank in the fuselages; any extra fuel needed was carried in drop tanks under the outer wings. The main fuel supply for all the Spitfire variants was in two forward fuselage tanks and any extra fuel needed was carried in a slipper tank under the

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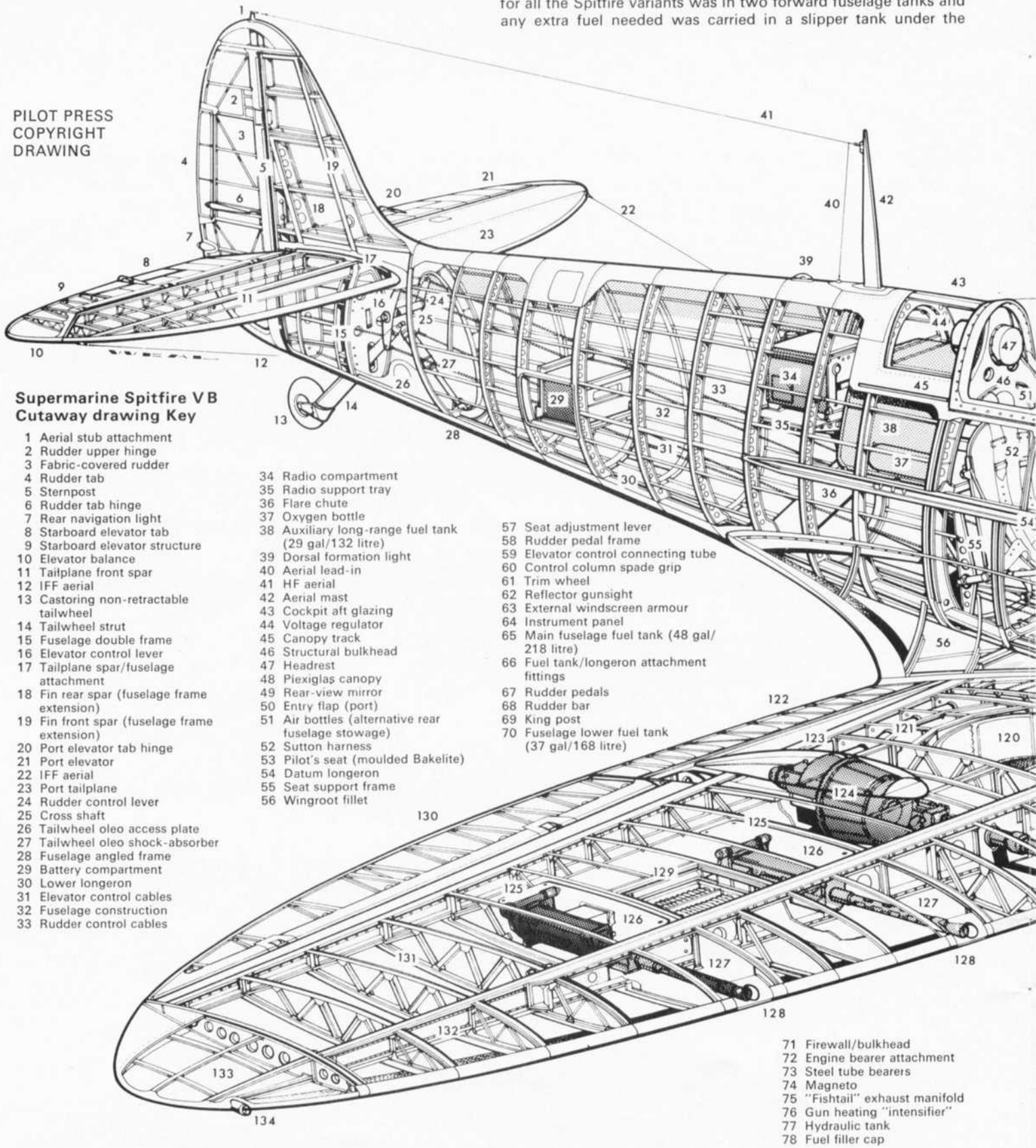


Supermarine Spitfire VB
Cutaway drawing Key

1 Aerial stub attachment
2 Rudder upper hinge
3 Fabric-covered rudder
4 Rudder tab
5 Sternpost
6 Rudder tab hinge
7 Rear navigation light
8 Starboard elevator tab
9 Starboard elevator structure
10 Elevator balance
11 Tailplane front spar
12 IFF aerial
13 Castoring non-retractable tailwheel
14 Tailwheel strut
15 Fuselage double frame
16 Elevator control lever
17 Tailplane spar/fuselage attachment
18 Fin rear spar (fuselage frame extension)
19 Fin front spar (fuselage frame extension)
20 Port elevator tab hinge
21 Port elevator
22 IFF aerial
23 Port tailplane
24 Rudder control lever
25 Cross shaft
26 Tailwheel oleo access plate
27 Tailwheel oleo shock-absorber
28 Fuselage angled frame
29 Battery compartment
30 Lower longeron
31 Elevator control cables
32 Fuselage construction
33 Rudder control cables
34 Radio compartment
35 Radio support tray
36 Flare chute
37 Oxygen bottle
38 Auxiliary long-range fuel tank (29 gal/132 litre)
39 Dorsal formation light
40 Aerial lead-in
41 HF aerial
42 Aerial mast
43 Cockpit aft glazing
44 Voltage regulator
45 Canopy track
46 Structural bulkhead
47 Headrest
48 Plexiglas canopy
49 Rear-view mirror
50 Entry flap (port)
51 Air bottles (alternative rear fuselage stowage)
52 Sutton harness
53 Pilot's seat (moulded Bakelite)
54 Datum longeron
55 Seat support frame
56 Wingroot fillet
57 Seat adjustment lever
58 Rudder pedal frame
59 Elevator control connecting tube
60 Control column spade grip
61 Trim wheel
62 Reflector gunsight
63 External windscreen armour
64 Instrument panel
65 Main fuselage fuel tank (48 gal/218 litre)
66 Fuel tank/longeron attachment fittings
67 Rudder pedals
68 Rudder bar
69 King post
70 Fuselage lower fuel tank (37 gal/168 litre)
71 Firewall/bulkhead
72 Engine bearer attachment
73 Steel tube bearers
74 Magneto
75 "Fishtail" exhaust manifold
76 Gun heating "intensifier"
77 Hydraulic tank
78 Fuel filler cap

fuselage; only in some later marks was any fuel carried in the wing – and sometimes, making the handling more difficult, in the rear fuselage.

Spitfire Initiation

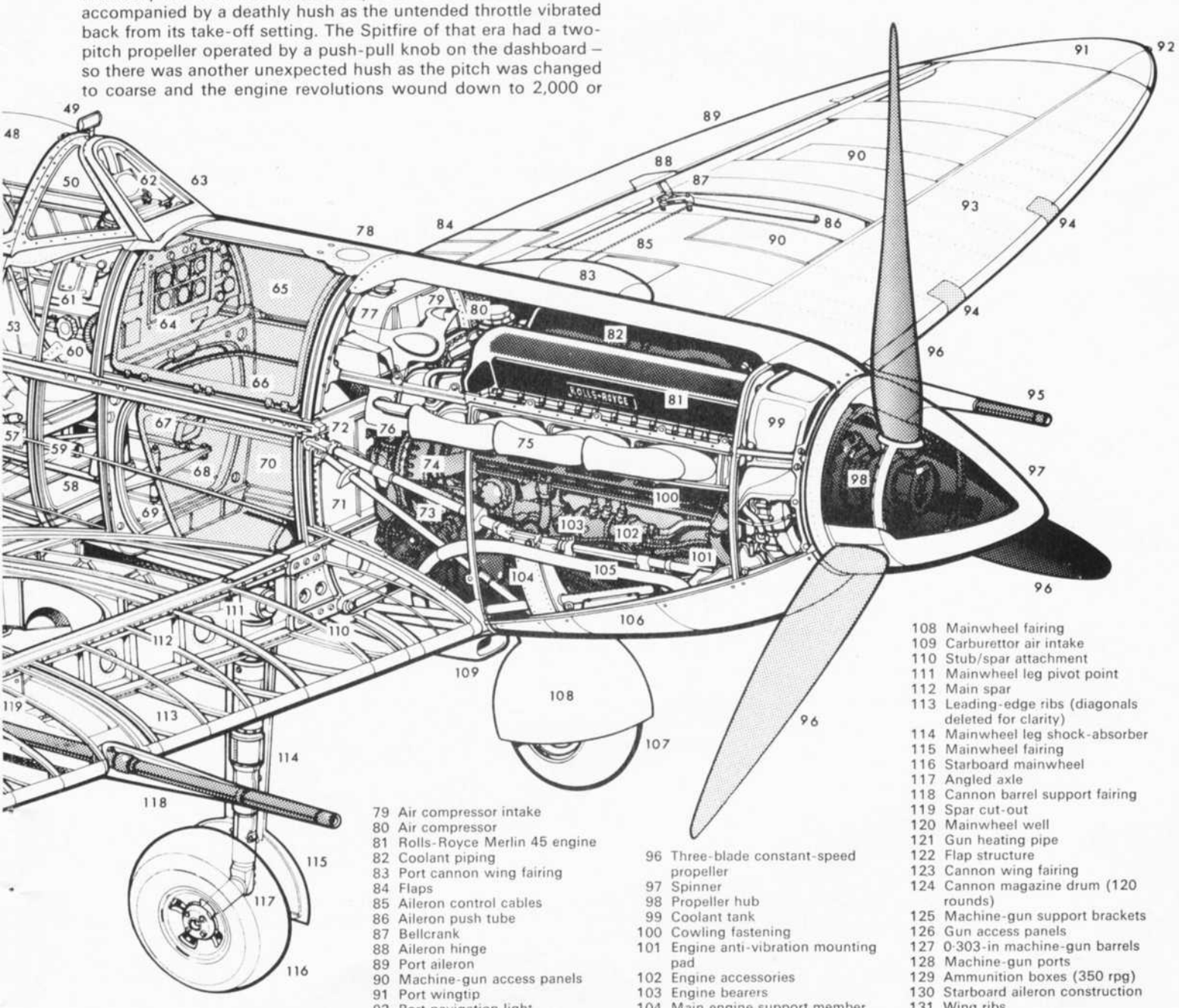
Remembered first impressions of aeroplanes can be unreliable when overlaid by later memories, but are usually sharp enough. Had I not, as a very inexperienced pilot of single-seat fighters, graduated via a Fairey Battle bomber and a few Hurricanes, my first flight in a Spitfire might have been remembered as a somewhat traumatic experience. This Mk I, which had to be taken from the manufacturer's factory at Eastleigh, Southampton, to the RAF maintenance unit at Cosford, near Wolverhampton, seemed such a cramped little thing with a big engine way ahead under a flat-topped cowling. The weather was poorish and visibility was reported to be even worse in the Midlands area – but all went reasonably well.

The take-off and initial climb were mildly troublesome because of a marked tendency to swing to port and the unexpectedly light elevator control. The stick-hand had to be changed immediately after take-off so as to select undercarriage "up" and to work an hydraulic hand-pump – there being no engine-driven pump in this early version. The climb-away was thus a see-saw affair, accompanied by a deathly hush as the untended throttle vibrated back from its take-off setting. The Spitfire of that era had a two-pitch propeller operated by a push-pull knob on the dashboard – so there was another unexpected hush as the pitch was changed to coarse and the engine revolutions wound down to 2,000 or less before the speed began to build up. Because the cockpit was so relatively far back, only the more prominent landmarks could be recognized, over the wing leading-edge, in the poor visibility.

Later delivery flights with the Spitfire were rather more pleasing – especially a 90-minute clear-weather flight from Eastleigh to the MU at Kirkbride, Cumberland, in May 1940. Four years later, when posted as a test pilot to the Spitfire-holding MU, I realized how primitive these early versions were. The unit was primarily concerned with storing and preparing later marks such as the IX, the Griffon-engined XII and XIV, and Seafires, but there were survivors among the more ancient variants, though these now had constant-speed propellers and engine-driven hydraulics.

Among little-known oddments at this MU were a number of Mk VIIs with cockpits pressurized to 2 lb/sq in (103 mm Hg) to give, assuming a continued oxygen supply, a fairly comfortable cabin pressure equivalent to 30,000 ft (9 145 m) when flying at 40,000 ft (12 192 m). Some had sealed sliding hoods, but others had their hoods clamped in place so that they could not be moved in the air other than by jettisoning. For the pilot, the situation was fairly claustrophobic, and the controls were very stiff because of the need for pressure-tight conduits.

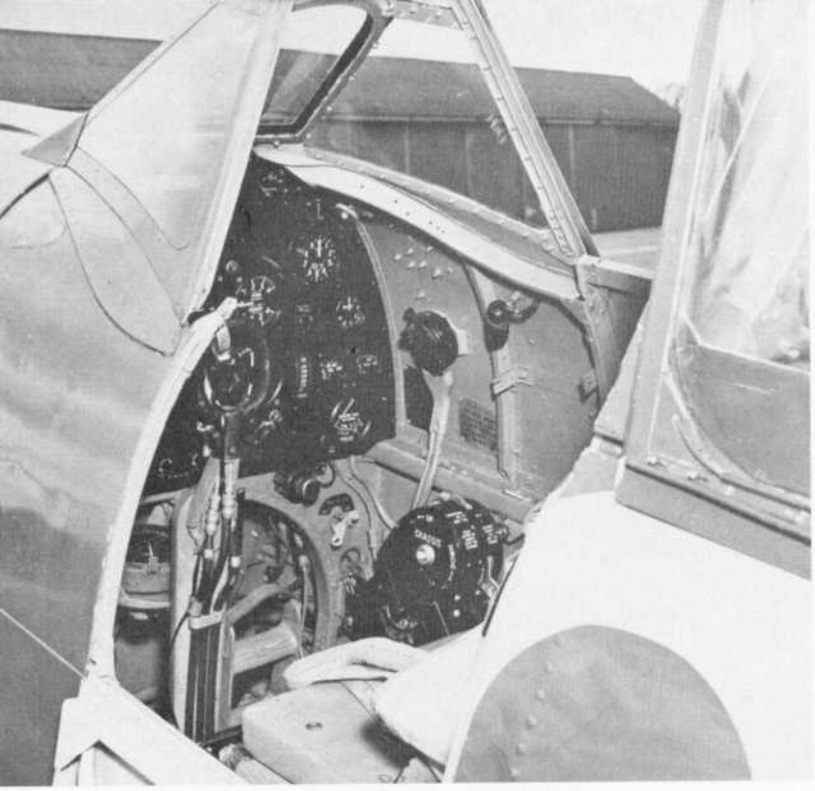
The nicest of all Spitfire variants were the Mk VIII and the



79 Air compressor intake
80 Air compressor
81 Rolls-Royce Merlin 45 engine
82 Coolant piping
83 Port cannon wing fairing
84 Flaps
85 Aileron control cables
86 Aileron push tube
87 Bellcrank
88 Aileron hinge
89 Port aileron
90 Machine-gun access panels
91 Port wingtip
92 Port navigation light
93 Leading-edge skinning
94 Machine-gun ports (protected)
95 20-mm cannon muzzle

96 Three-blade constant-speed propeller
97 Spinner
98 Propeller hub
99 Coolant tank
100 Cowling fastening
101 Engine anti-vibration mounting pad
102 Engine accessories
103 Engine bearers
104 Main engine support member
105 Coolant pipe
106 Exposed oil tank
107 Port mainwheel

108 Mainwheel fairing
109 Carburettor air intake
110 Stub/spar attachment
111 Mainwheel leg pivot point
112 Main spar
113 Leading-edge ribs (diagonals deleted for clarity)
114 Mainwheel leg shock-absorber
115 Mainwheel fairing
116 Starboard mainwheel
117 Angled axle
118 Cannon barrel support fairing
119 Spar cut-out
120 Mainwheel well
121 Gun heating pipe
122 Flap structure
123 Cannon wing fairing
124 Cannon magazine drum (120 rounds)
125 Machine-gun support brackets
126 Gun access panels
127 0·303-in machine-gun barrels
128 Machine-gun ports
129 Ammunition boxes (350 rpg)
130 Starboard aileron construction
131 Wing ribs
132 Single-tube outer spar section
133 Wingtip stricture
134 Starboard navigation light



The Spitfire cockpit – in this case, a Mk V. Location of the undercarriage selector to the right meant that the aircraft had to be flown with the left hand on the stick immediately after take-off, as described in the text

photographic reconnaissance (PR) Mk XI produced by the primary manufacturers. I learned about these during a five-week stint as a production-line test pilot working from three dispersed assembly plants – one of which had, for its aerodrome, nothing better than a very large field used in peacetime for racehorse training. From these satellite "factories" the newly-assembled aircraft were taken up on strictly-controlled tests.

They were first climbed at an accurately-held indicated speed to note the height to which the medium-supercharge boost pressure was maintained at rated power ("full-throttle height"), and thence to that at which the blower gear automatically changed to full supercharge. Thereafter, the speed in level flight at rated power had to be checked before descending in a dive to a stipulated maximum airspeed so as to make sure that nothing came apart and that the handling was normal. Meanwhile, the pressures, temperatures and other figures had to be checked and the lateral trim changes noted for future adjustment and re-test.

All this had to be done without radio aids and in all weathers so long as the cloud-base was not too low and the visibility reasonably good below this base. The pilots had devised a simple routine which ensured a comparatively reliable return to the take-off point. The climb was made up-wind, the level-speed run down-wind and the final dive up-wind. So long as there were not too many repeat checks to be made, this brought one back more or less to the area of the satellite field. If no landmark could be recognized quickly on breaking cloud, we flew south to the Channel coast and map-read our way back home.

Only once was I hopelessly lost after a long series of high-level checks with a PR XI. Fortunately, I spotted a large runway-ed aerodrome before fuel was running low; unable to recognize it, I landed and made the humiliating inquiry in the watch-office – to discover that it was no more than 15 miles from base. The PR XI was especially pleasing to fly because it had no guns and no cumbrous gyro-gunsight obscuring the view through a plain curved screen. It also carried some useful extra fuel in the leading-edges.

The lateral trim adjustment on all later Spitfires up to the Mk 21 was made by reflexing, or dressing upwards, the metal trailing-edge of the aileron on the wing-down side, and we became fairly clever at judging how much adjustment was needed – though not as clever as the riggers who had to translate into action the varying explanations given. These could be expressed as "inches" of reflex, or degrees of wing-down-ness based on the amount of skid (shown on the slip indicator) when using the rudder to hold the wing up.

The Spitfire XIV, with its Griffon engine and big five-bladed propeller, was something of a monster to look at, but except on take-off, handled like any other Spitfire and could be floated in on a nose-high turn with a whiff of power. The take-off was mildly alarming at first not only because the aircraft tried, very strongly, to swing to starboard and one feared for the propeller tips when lifting the tail, but because, with so much power, torque and rudder-trim, it was never going where it was pointing along the runway. We learned to be very gentle with the big, long-travel throttle and to use no more than plus 9 lb (1,225 mm Hg) of boost until airborne.

At the time when I was flying Spitfire XIVs they were being fitted with an interconnection between the throttle and propeller controls. This modification involved inter-related adjustments to the throttle and propeller-control rods, the throttle-gate stops and the boost setting. The engineers soon learned to make sense of the mass of boost and engine-revolution figures which we brought back on our knee-pads and would get everything right after, at the most, a couple of tries.

Two very different marks of Spitfires were appearing at MUs from the end of 1944 onwards. These were the XVI and the 21 – for which mark the clumsy Roman numerals were at last dropped. The XVI was, in effect, an updated, clipped-wing Mk IX powered by a Packard-built Merlin with a maximum short-period boost pressure, using 150-grade fuel, of plus 25 lb (2,053 mm Hg). The idea, we were told, was to give it low-level acceleration and speed to overtake and destroy V-1 "flying bombs". We checked that all these pounds of boost were available while praying that the engine would stay in one piece.

The Mk 21 looked like a XIV, but did not feel like one. The XIV had already lost a little of its Spitfire-ishness because of a balance-tab on the rudder, which lightened it, but caused an uncomfortable tendency for the aircraft to yaw about in a dive, however gently one tried to use one's feet. The Spitfire 21 had balance tabs for the ailerons and a slightly different, taller, undercarriage. It was a mighty device, with a combat rate-of-climb of about 4,500 ft/min (22,9 m/sec) at 5,000 ft (1 525 m) and a maximum speed of more than 440 mph (708 km/h) at 22,000 ft (6 705 m) – but it was not really a Spitfire any more.

Handling the Hurricane

Whether through good luck or good maintenance, the Hurricane was, for me, not only the easiest to fly but the most reliable of any wartime aeroplanes. During nearly 300 hours of test flying at an MU where many other, some very troublesome, types were stored and equipped, I experienced no more than two or three precautionary landings because of incipient engine failure, and only one fraught situation in which abandonment by parachute was no more than half-heartedly considered. Hurricanes were used at the unit, in preference to any lighter and more civilized aircraft which were available, for weather tests and for urgent trips to collect spare parts when these were small enough to be fitted into gun bays; they were regularly ferried without anxiety between the MU and its various dispersal fields.

Least likeable were the earliest versions. These had an hydraulic "power lever" which had to be held down with the stick-hand during undercarriage and flap operation after selecting the appropriate action, using a single lever in a five-position gate on the right. They also had fabric-covered wings with rather heavy ailerons and no manual trim adjustment for the rudder. The nicest, curiously enough, were the Mk IICs, heavily loaded though they sometimes were for test, with four cannon, their ammunition and two 90-gallon (410-litre) long-range drop-tanks.

Almost the only faults of these and other developed versions were a tendency to "bucket" during take-off from rough fields and to "tighten-up", as mentioned earlier, in steep turns and pull-outs from dives. It was a trifle odd, at first, to find oneself instinctively holding hard forward pressure on the control-column as the *g*-loads built up during a tight turn. In all marks the view was excellent, especially with the flaps down for the approach, and the elevator control, though somewhat heavy with power on and at higher speeds, seemed just right for the Hurricane; when the throttle was closed before touchdown the elevator load tightened so that smooth three-pointers could be made as a matter of course without the effort and concentration sometimes needed with other types.

Trimming adjustments, especially with the earlier variants, could be an interesting exercise in compromise. The ailerons had no tabs and corrections were made by doping lengths of cord on

the upper trailing-edge of the aileron of the wing which needed "lifting" – so we spoke in our test reports of, for instance, "five inches left-wing low", and that length of cord was applied for further trial. The plot was to get the lateral trim right at maximum cruise speed; we then dived the Hurricane to around 350 mph (560 km/h) indicated to make sure that any developing out-of-trim-ness could be held comfortably. Before rudder-bias gear was fitted, directional trim was adjusted for "feet-off" dives – on the assumption that most legs were strong enough to hold any minor yawing tendency at lower speeds.

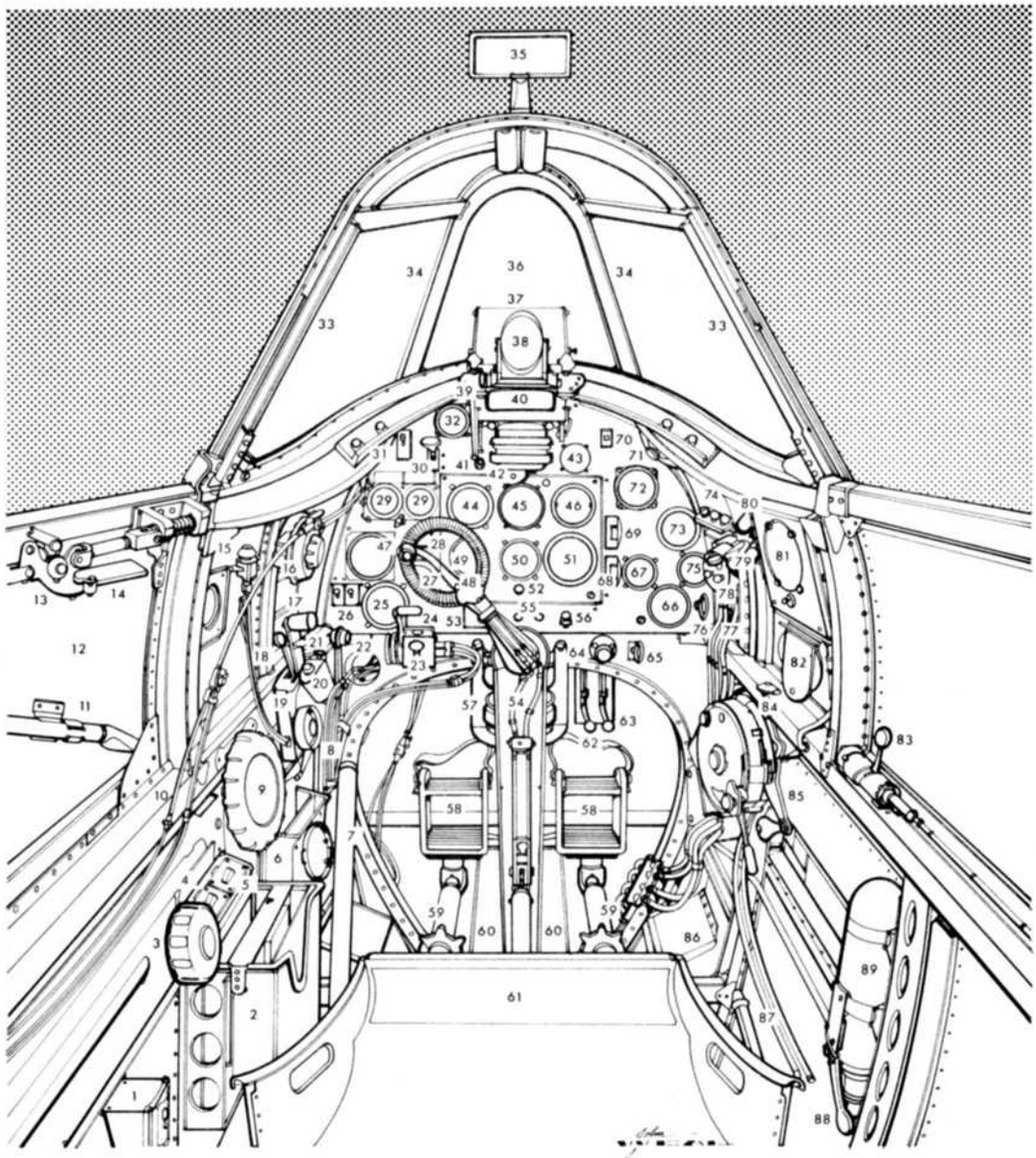
During one period the MU ran into persistent trouble with undercarriages which would not lock up and this led to the fraught situation mentioned. The locking-stirrups on the legs had to pass through fibre guides in the wheel-well cover-plates and, unless correctly aligned, they sometimes would not do this. For me, one stirrup had refused to go through the plate and the other had broken its way through and was wedged behind it. So I was left with a displeasing circumstance where one leg was immovably locked up and the other was dangling in the slipstream. Samsonian efforts on the hand-pump, aided by adrenalin in the bloodstream, eventually provided enough hydraulic urge to break the leg free.

The most enjoyable flights in Hurricanes – if one can dare to admit to pleasure during an uncomfortable and dangerous war – were those made on consumption tests with Mk IIs at various periods during 1941 and 1942. The method used was simple but effective. After taking off, climbing and settling down to a level cruise at 2,000 ft (610 m) using 2,000 rpm and plus 2 lb (863 mm Hg) of boost, using fuel from the small fuselage tank, the feed was switched over to the full main tanks and a stop-watch clicked into action. An hour later the feed was selected back to the fuselage tank for the circuit and landing. On the ground, the amount of fuel needed to top-up the main tanks was measured.

Quite a lot of landscape could be covered during the restful hour's flight from RAF Hawarden, Chester, including, according to the weather conditions, the panoramas of Snowdonia and even those of the borders of the Lake District – but it was obviously important not to loiter for too long in admiration of the English landscape. The cruising speed at this power setting was fairly low and failure to reach home within the hour could, with little fuel

Supermarine Spitfire Mk II Cockpit Instrumentation Key

1 Flare release control
2 Map stowage box
3 Rudder trim tab control wheel
4 Pitot head heater switch
5 Camera gun master switch
6 Notepad holder
7 Radiator flap control lever
8 Throttle and mixture friction adjusters
9 Elevator trimming tab control wheel
10 Wireless leads
11 Escape crowbar (clip stowage)
12 Entry door panel
13 Door catch mechanism
14 Lock/unlock lever
15 Camera gun film footage indicator connection
16 Wireless remote controller
17 Throttle lever
18 Mixture control lever
19 Throttle quadrant
20 Warning horn override/cut-out switch
21 Boost cut-out control
22 Propeller pitch control lever
23 Landing lamp lowering control
24 Landing lamp dipping lever
25 Brake triple pressure gauge
26 Main magneto switches
27 Elevator trim tabs position indicator (partially obscured by control grip)
28 Undercarriage position indicator
29 Oxygen regulator gauges
30 Flaps control
31 Navigation lights switch
32 Flaps position indicator
33 Canopy frame
34 Windshield frame
35 Rear-view mirror
36 Windshield
37 Gunsight dimming screen (shown 'up')
38 Type GM2 reflector gunsight
39 Dimming screen lifting ring
40 Gunsight mounting
41 Reflector sight main switch
42 Reflector sight lamp dimmer switch (obscured by mounting)
43 Ammeter
44 Airspeed indicator
45 Artificial horizon
46 Rate-of-climb indicator
47 Gun button (on control grip)
48 Brake lever
49 Altimeter (partially obscured by control grip)
50 Direction indicator
51 Turning indicator
52 Direction indicator setting knob
53 Compass deviation card holder
54 Control column
55 Cockpit lamp dimmer switches
56 Engine starting pushbutton
57 Compass (obscured by control column)
58 Rudder pedals
59 Rudder pedal leg-reach adjustment starwheels
60 Heelrests
61 Pilot's seat
62 Fuel cock lever (bottom tank)
63 Fuel cock lever (top tank)
64 Priming pump
65 Slow-running cut-out control ring
66 Fuel contents gauge
67 Oil temperature gauge
68 Oil pressure gauge
69 Fuel pressure gauge
70 Generator switch
71 Cockpit ventilator control
72 Engine speed indicator
73 Boost gauge
74 Reflector sight spare filaments (3)
75 Radiator temperature gauge
76 Cartridge starter reload control
77 Engine data plate
78 Signalling switch box
79 Oxygen socket
80 Cockpit lamp
81 Wireless remote contactor mounting and switch
82 Height and airspeed computor stowage
83 Harness release
84 Control locking lug
85 Undercarriage control lever
86 Control locking lug
87 Seat adjustment lever
88 Undercarriage emergency lowering lever
89 CO_2 bottle



remaining in the fuselage tank, mean switching back to the mains – thus ruining the test.

Another welcome relief from normal routine was that of test-firing the four 20-mm Hispano cannon in Hurricane IICs, when innocent non-explosive rounds were fired, during a low-level dive, into the sea off the coast of North Wales. The recoil of the guns produced a mild nose-down effect and one needed to be ready to correct a sudden yaw when and if one of the four guns failed to deliver.

The Hurricane was slower than the Spitfire – but not that much so. An equivalently-armed Hurricane II had a top speed of about 340 mph (547 km/h) against the Spitfire V's 375 mph (604 km/h). Even with two 90-gallon (410-litre) drop tanks and four cannon, the Hurricane IIC still managed a true air speed of around 305 mph (490 km/h) at 20,000 ft (6 096 m).

The Opposition

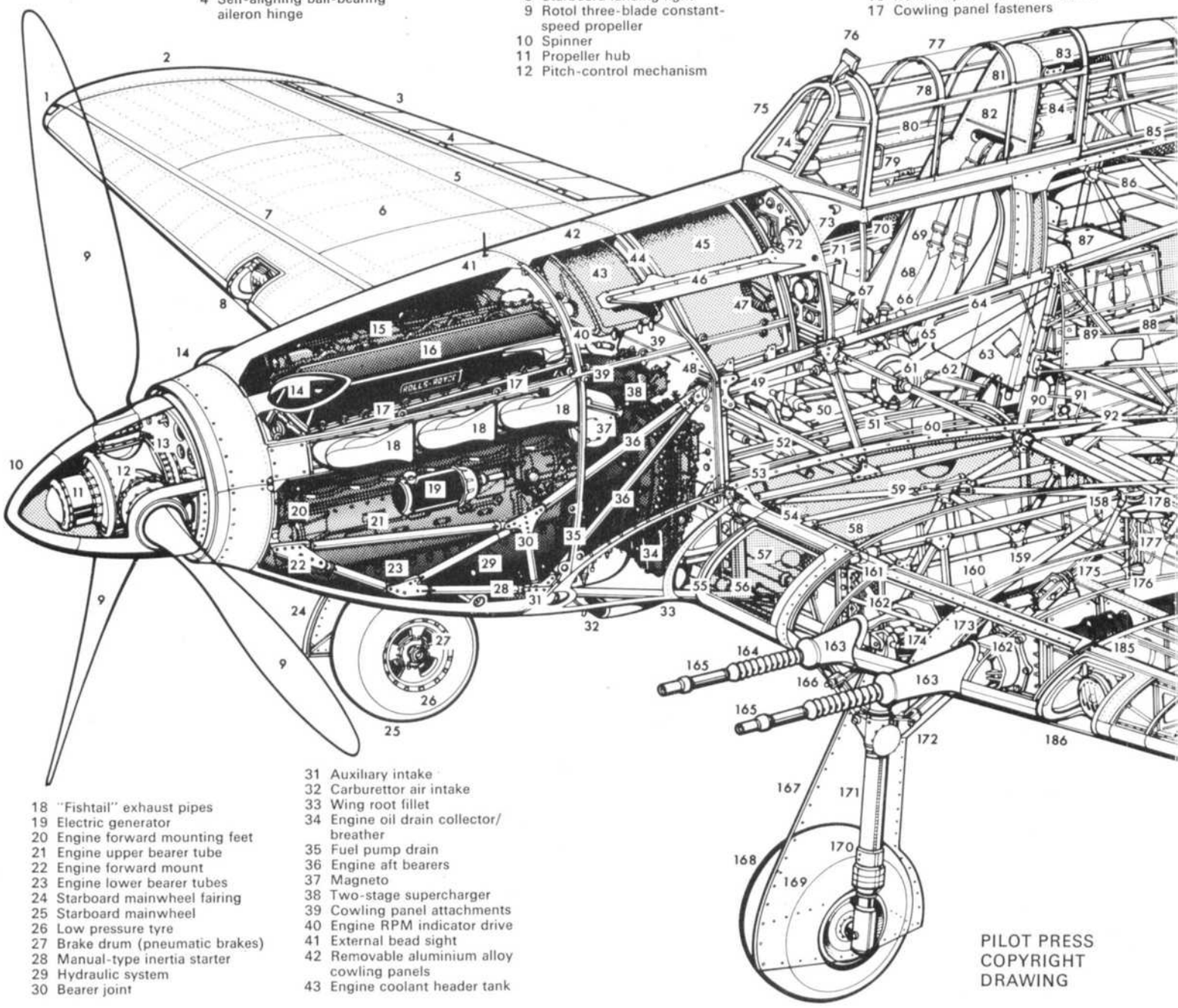
THE EARLY YEARS in the operational careers of both Messerschmitt Bf 109 and Focke-Wulf Fw 190 had one thing in common – a carefully-fostered mystique. The German propaganda machine assiduously created myths of invincibility around these fighters; myths to which the *Luftwaffe* itself in part fell victim owing to the apparent ease with which the Bf 109 bested most of its adversaries in the pre-Battle of Britain fighter scenario, and the undeniable mastery over the then contemporary Spitfire V that the Fw 190 established when first committed to combat on the so-called Channel Front.

Despite awesome reputations for combat efficiency, there was, in fact, nothing *mysterious* about either Bf 109 or Fw 190; both were simply well-conceived and soundly-designed fighters capable of maintaining in maturity the success that attended their infancy. Like the Spitfire and Hurricane – though, in truth, the Focke-Wulf fighter was of a later generation in those now long-past days when fighter development tempo had accelerated to such a degree that a 'generation' encompassed a mere half-decade or less – these German warplanes proved amenable to the introduction of progressively more powerful engines and armament, and yet, in essence, retained throughout the characteristics responsible for their original success, as well as the shortcomings inherent in their original concept.

The Bf 109 was to be acclaimed as a prototype for international fighter development, but, as with so many claims to technological

Hawker Hurricane Mk IIC Cutaway Drawing Key

1 Starboard navigation light
2 Starboard wingtip
3 Aluminium alloy aileron
4 Self-aligning ball-bearing aileron hinge
5 Aft wing spar
6 Aluminium alloy wing skinning
7 Forward wing spar
8 Starboard landing light
9 Rotol three-blade constant-speed propeller
10 Spinner
11 Propeller hub
12 Pitch-control mechanism
13 Spinner back plate
14 Cowling fairings
15 Coolant pipes
16 Rolls-Royce Merlin XX engine
17 Cowling panel fasteners



18 "Fishtail" exhaust pipes
19 Electric generator
20 Engine forward mounting feet
21 Engine upper bearer tube
22 Engine forward mount
23 Engine lower bearer tubes
24 Starboard mainwheel fairing
25 Starboard mainwheel
26 Low pressure tyre
27 Brake drum (pneumatic brakes)
28 Manual-type inertia starter
29 Hydraulic system
30 Bearer joint
31 Auxiliary intake
32 Carburettor air intake
33 Wing root fillet
34 Engine oil drain collector/breather
35 Fuel pump drain
36 Engine aft bearers
37 Magneto
38 Two-stage supercharger
39 Cowling panel attachments
40 Engine RPM indicator drive
41 External bead sight
42 Removable aluminium alloy cowling panels
43 Engine coolant header tank

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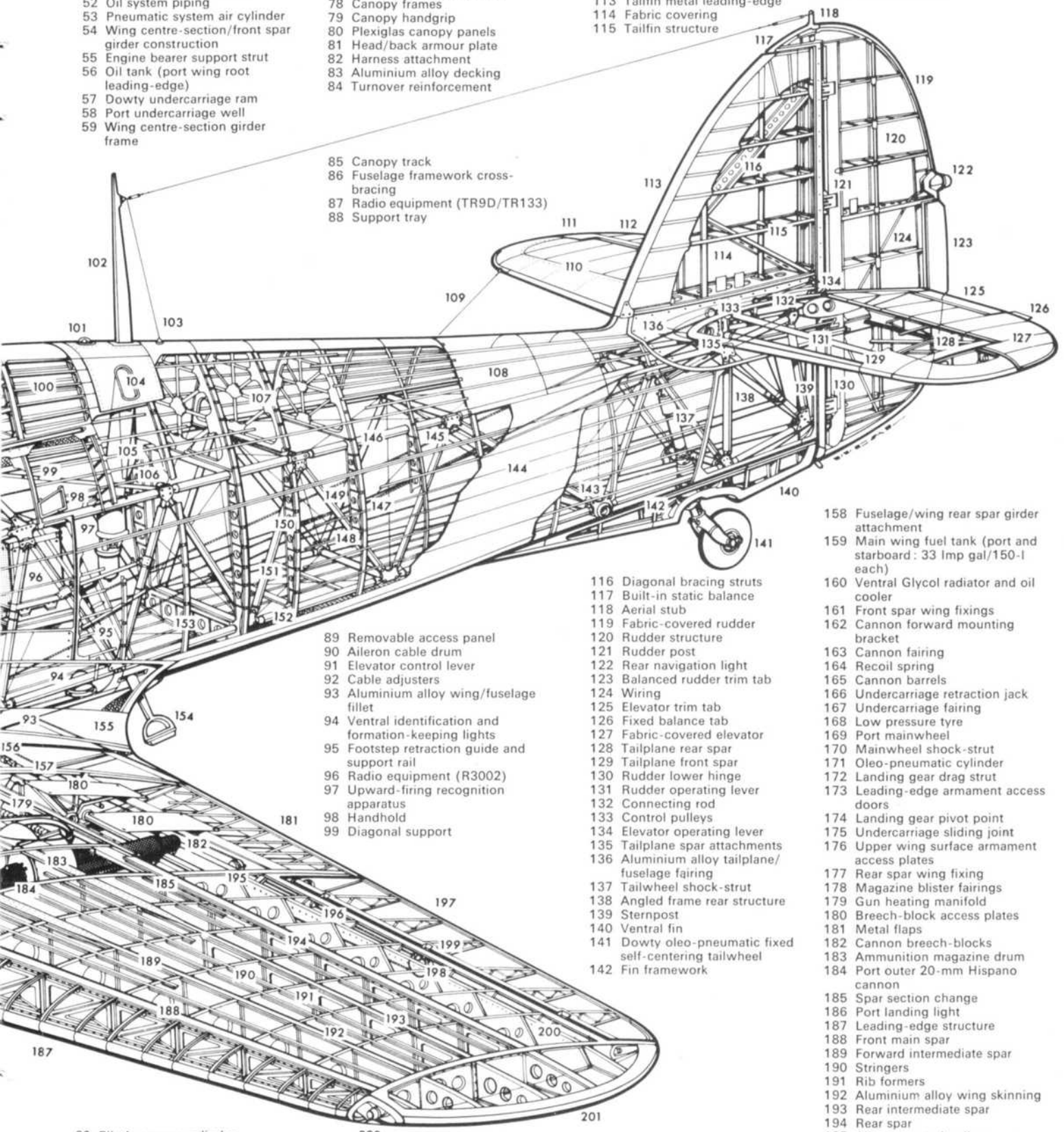


44 Engine firewall (armour-plated backing)
45 Fuselage (reserve) fuel tank (28 Imp gal/127 l)
46 Exhaust glare shield
47 Control column
48 Engine bearer attachment
49 Rudder pedals
50 Control linkage
51 Centre-section fuel tank
52 Oil system piping
53 Pneumatic system air cylinder
54 Wing centre-section/front spar girder construction
55 Engine bearer support strut
56 Oil tank (port wing root leading-edge)
57 Dowty undercarriage ram
58 Port undercarriage well
59 Wing centre-section girder frame

60 Pilot's oxygen cylinder
61 Elevator trim tab control wheel
62 Radiator flap control lever
63 Entry footstep
64 Fuselage tubular framework
65 Landing lamp control lever
66 Oxygen supply cock
67 Throttle lever
68 Safety harness
69 Pilot's seat
70 Pilot's break-out exit panel
71 Map case
72 Instrument panel
73 Cockpit ventilation inlet
74 Reflector gunsight
75 Bullet-proof windscreen
76 Rear-view mirror
77 Rearward-sliding canopy
78 Canopy frames
79 Canopy handgrip
80 Plexiglas canopy panels
81 Head/back armour plate
82 Harness attachment
83 Aluminium alloy decking
84 Turnover reinforcement

85 Canopy track
86 Fuselage framework cross-bracing
87 Radio equipment (TR9D/TR133)
88 Support tray

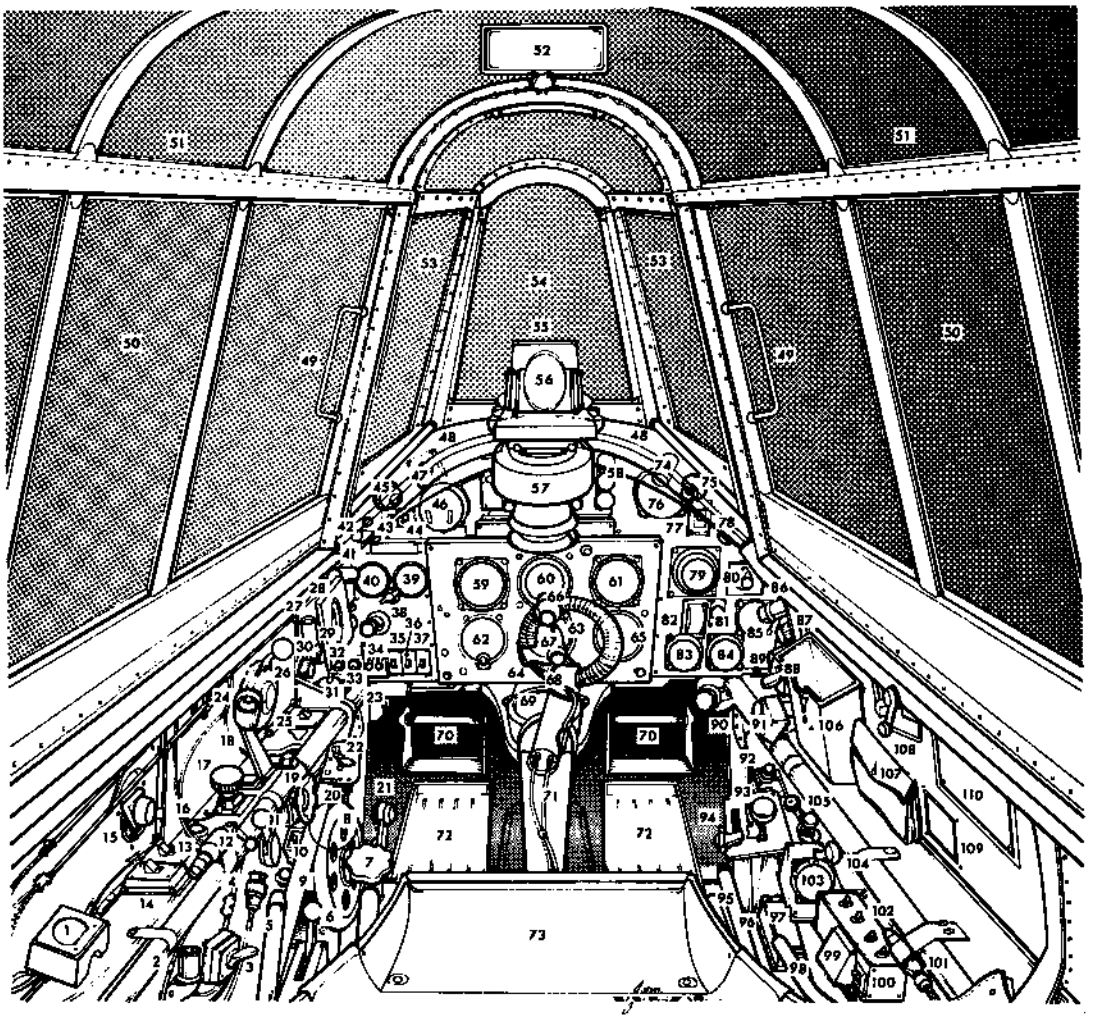
89 Removable access panel
90 Aileron cable drum
91 Elevator control lever
92 Cable adjusters
93 Aluminium alloy wing/fuselage fillet
94 Ventral identification and formation-keeping lights
95 Footstep retraction guide and support rail
96 Radio equipment (R3002)
97 Upward-firing recognition apparatus
98 Handhold
99 Diagonal support

100 Fuselage fairing
101 Dorsal identification light
102 Aerial mast
103 Aerial lead-in
104 Recognition apparatus cover panel
105 Mast support
106 Wire-braced upper truss
107 Wooden fuselage fairing formers
108 Fabric covering
109 Radio antenna
110 All-metal tailplane structure
111 Static and dynamic elevator balance
112 Starboard elevator
113 Tailfin metal leading-edge
114 Fabric covering
115 Tailfin structure

116 Diagonal bracing struts
117 Built-in static balance
118 Aerial stub
119 Fabric-covered rudder
120 Rudder structure
121 Rudder post
122 Rear navigation light
123 Balanced rudder trim tab
124 Wiring
125 Elevator trim tab
126 Fixed balance tab
127 Fabric-covered elevator
128 Tailplane rear spar
129 Tailplane front spar
130 Rudder lower hinge
131 Rudder operating lever
132 Connecting rod
133 Control pulleys
134 Elevator operating lever
135 Tailplane spar attachments
136 Aluminium alloy tailplane/fuselage fairing
137 Tailwheel shock-strut
138 Angled frame rear structure
139 Sternpost
140 Ventral fin
141 Dowty oleo-pneumatic fixed self-centering tailwheel
142 Fin framework

143 Handling-bar socket
144 Fabric covering
145 Swaged tube and steel gusset fitting and through bolts
146 Upper tube/longeron
147 Rudder cables
148 Wooden stringers
149 Elevator cables
150 Aluminium alloy formers
151 Diagonal brace wires
152 Lower tube/longeron
153 Aluminium alloy former bottom section
154 Retractable entry footstep
155 Wingroot fillet
156 Flap rod universal joint
157 Aileron cables

158 Fuselage/wing rear spar girder attachment
159 Main wing fuel tank (port and starboard: 33 Imp gal/150-l each)
160 Ventral Glycol radiator and oil cooler
161 Front spar wing fixings
162 Cannon forward mounting bracket
163 Cannon fairing
164 Recoil spring
165 Cannon barrels
166 Undercarriage retraction jack
167 Undercarriage fairing
168 Low pressure tyre
169 Port mainwheel
170 Mainwheel shock-strut
171 Oleo-pneumatic cylinder
172 Landing gear drag strut
173 Leading-edge armament access doors
174 Landing gear pivot point
175 Undercarriage sliding joint
176 Upper wing surface armament access plates
177 Rear spar wing fixing
178 Magazine blister fairings
179 Gun heating manifold
180 Breech-block access plates
181 Metal flaps
182 Cannon breech-blocks
183 Ammunition magazine drum
184 Port outer 20-mm Hispano cannon
185 Spar section change
186 Port landing light
187 Leading-edge structure
188 Front main spar
189 Forward intermediate spar
190 Stringers
191 Rib formers
192 Aluminium alloy wing skinning
193 Rear intermediate spar
194 Rear spar
195 Aileron control pulley
196 Aileron inboard hinge
197 Aluminium alloy aileron
198 Aileron control gear main pulley
199 Self-aligning ball-bearing hinge
200 Aileron outboard hinge
201 Detachable wingtip
202 Port navigation light



Hawker Hurricane Mk IIC Cockpit Instrumentation Key

1 Voltmeter
2 Microphone/telephone socket
3 Cannon cocking lever
4 Heated clothing socket
5 Radiator flap control lever
6 Recognition device (flare) selector lever
7 Rudder trimming tab control wheel
8 Elevator trimming tab control wheel
9 Fuel tank pressurising control
10 TR9D contactor switch
11 Landing lamp control lever
12 Hood catch control
13 Generator switch
14 Radio contactor master switch
15 Cockpit light dimmer switch
16 Oil dilution pushbutton
17 Oxygen supply cock
18 Throttle lever
19 Friction adjuster
20 Radio contactor (obscured by tubular frame member)
21 Undercarriage emergency release lever
22 Fuel cock control
23 Supercharger control
24 Rocket-projectile firing button (throttle-mounted)
25 Cannon master switch
26 Propeller speed control
27 Footage indicator plug socket
28 Camera gun footage indicator wedge plate
29 Cockpit light dimmer switch
30 Compass light dimmer switch
31 Landing lamp switch
32 Engine starter pushbutton
33 Booster coil pushbutton
34 Ignition switches: magnetos No 1 (left) and 2 (right)
35 Pressure (pitot) head heater switch
36 Navigation lights switch
37 Camera gun switch
38 Boost control cut-out
39 Oxygen supply contents gauge
40 Oxygen supply flow-meter
41 Cockpit light
42 Power failure warning light
43 Undercarriage indicator ON/OFF switch
44 Undercarriage indicator change-over switch
45 Cockpit ventilator (port)
46 Undercarriage indicator
47 Rocket-projectile selector switch
48 Instrument panel coaming
49 Canopy hood handgrips
50 Plexiglas canopy panels
51 Canopy frame
52 Rear-view mirror
53 Windshield frame
54 Bullet-proof windshield
55 Gunsight anti-glare screen
56 Reflector-type gunsight
57 Gunsight mounting
58 Reflector sight spare filaments (3)
59 Airspeed indicator
60 Artificial horizon
61 Rate of climb/descent indicator
62 Altimeter
63 Direction indicator (partially obscured by control grip)
64 Direction indicator setting knob (obscured by cohtrol grip)
65 Turning indicator
66 Gun button (on control grip)
67 Brake lever
68 Control grip
69 Compass (partially obscured by control column)
70 Rudder pedals
71 Control column
72 Heel rests
73 Pilot's seat
74 Instrument panel light
75 Cockpit ventilator (starboard)
76 Engine speed indicator
77 Reflector sight switch
78 Instrument panel light dimmer switch
79 Boost gauge
80 Fuel contents gauge selector switch
81 Fuel pressure warning light
82 Oil pressure gauge
83 Oil temperature gauge
84 Radiator temperature gauge
85 Fuel contents gauge
86 Cockpit light
87 Cockpit light dimmer switch
88 Signalling switch box
89 Beam-approach master switch
90 Cylinder priming pump
91 Container jettison pushbutton
92 Slow-running cut-out
93 Undercarriage and flap selector lever
94 Undercarriage selector safety catch
95 Emergency crowbar (clip stowage to right of seat)
96 Seat adjustment lever
97 Flap indicator
98 Hydraulic handpump
99 IFF (R3002) pushbuttons (covered)
100 IFF (R3002) master switch
101 Sutton harness release
102 Bomb fusing and selector switch panel
103 Drop-tank fuel cock control
104 Drop-tank jettison control
105 Windscreen de-icing pump
106 Map/document stowage
107 Equipment pouch
108 Emergency exit panel jettison lever
109 Data plate
110 Fuel gauge conversion tables

development precedence, this was but a half-truth. If not the *first* single-seat cantilever fighter monoplane embellished by cockpit canopy and retractable undercarriage, and utilising an all-metal stressed-skin monocoque structure, it *was* the first such to enter service and its début unquestionably stimulated international fighter evolution. Following in prototype form just short of four years in the wake of the Messerschmitt, the Fw 190, on the other hand, proffered no such combination of innovatory features as did its compatriot, but embodied no less ingenuity and was certainly not short on novelty. They emulated their British counterparts in being very good designs; only very good designs could possibly have accommodated the constantly changing demands of the air war of those days.

One of the first German combat aircraft received at the Royal Aircraft Establishment was, in fact, a Messerschmitt Bf 109E-3 of *II Gruppe* of *Jagdgeschwader* 54, which arrived at Farnborough on 14 May 1940, having landed six months earlier near Woerth, Bas-Rhin, the bewildered and not a little embarrassed *Oberfeldwebel* flying the fighter having believed himself to be on the *German* side of the border. This aircraft was eventually to be shipped to Wright Field in April 1942, but not before we had acquired another airworthy example of this much-vaunted German fighter by dint of marrying the fuselage and power plant of one aircraft to wings, tail unit and propeller from others.

My first experience of the Messerschmitt came when I flew the Bf 109E-3 at Duxford, this leaving me with a lasting impression of near-instantaneous throttle response, a remarkably short take-off run and a very good initial climb rate; the positive feel and brisk response of the ailerons which progressively heavied up with speed and tended to snatch disconcertingly when the slots opened during manœuvring; the crisp responsiveness of the elevator which became very heavy in a dive; the lack of rudder trimmer which necessitated quite a bit of left rudder being applied as speed built up in order to keep the aircraft straight and the nasty flick stall. By the time I clambered into a Bf 109E, however, this version of Willy Messerschmitt's fighter was long *passé*. We had received a fairly steady supply of successive versions which had enabled us to keep a check on the Bf 109's performance *vis-à-vis* its British contemporaries in the see-saw battle for supremacy. At one time, late in 1942, the Spitfire IX widened the performance gap

so much that the Messerschmitt temporarily disappeared from the chart to be replaced by the Fw 190A, but then came what was probably the most efficient of the long-lived Messerschmitt breed, the Bf 109G series, or *Gustav* as it was widely but unofficially known, and the see-saw tipped in the opposite direction once more.

Deserving of Respect

Inevitably a *Gustav* eventually reached us at Farnborough. This particular aircraft, which, to be precise, was a Bf 109G-6/U2, had landed in error at Manston on 21 July 1944, and to my mind it was a sinister-looking aeroplane from any angle, with little remaining of the angular daintiness that had characterised the Bf 109E. Nevertheless, the very much more powerful engine and armament that it possessed had returned it to the forefront of the fighter scene, and although there were many *Luftwaffe* pilots who were to claim that the F-series had carried the Bf 109 to the zenith of its development cycle, *Gustav*, which, with its higher weight and power loadings, reflected the greater importance attached to speed and flexibility of rôle than to handling and manœuvrability, was a fighter deserving of respect when competently flown, a fact that few Allied fighter pilots would dispute.

The claustrophobic cockpit – small and narrow with a cumbersome hood that was difficult to open from the inside and incorporated rather primitive sliding panels – had changed little from that of the E-series, or *Emil*, and space was so confined that movement of the head was difficult for a pilot of even my limited stature. The blind-flying panel appeared somewhat better equipped than that of the contemporary Fw 190. The auxiliary services were mostly electrical, apart from the undercarriages and radiator which were hydraulically operated, and the flaps which were directly connected to a manually-operated handwheel and consequently tediously slow to lower. The engine starting system was of the inertia type whereby a flywheel was wound up by one of the groundcrew turning a handle until sufficient revs were obtained to engage the starter clutch control by the pilot pulling out a handle positioned beside his left knee. The Daimler-Benz DB 605A engine emitted a pleasantly powerful throaty roar as it warmed up at 1,900 rpm while the magneto, fuel pumps and pressures, and temperatures were checked, and as with the earlier DB 601A, its response to throttle movement was particularly good.

The forward view for taxying was terrible but at least *Gustav* was easily steerable owing to its positive toe pedal-operated wheel brakes, and using 15 degrees of flap and 1·3 *atas* (16·1 lb) boost, take-off was commendably short and certainly superior to that of the Spitfire IX in distance of run. The strong swing to port could easily be held on rudder, but it was desirable to raise the tail as rapidly as possible owing to the poor forward view. This could be done fairly coarsely without fear of the propeller hitting the ground as the high thrust line of the inverted-vee engine gave ample clearance. The Bf 109G had to be flown off as any attempt to *pull* it off the ground early resulted in aileron snatching as the wing slots opened unevenly.

The mainwheels retracted quickly but airscrew pitch changing was slow. The flaps were raised manually by means of the outer of two concentrically-mounted wheels to the pilot's left, the inner wheel adjusting tailplane incidence. Thus the wheels could be moved together to counteract the change in trim as the flaps came up. The Bf 109G-6 climbed well and at a steep angle, the actual climb rate being of the order of 3,800 ft/min (19,3 m/sec) at sea level. Stability was excellent in the longitudinal and lateral planes but was almost neutral directionally, and control harmony left something to be desired, the rudder being light, the ailerons moderately light and the elevators extremely heavy. This elevator heaviness was perhaps a necessity in view of the high wing loading as over-application of longitudinal control in manœuvres easily induced the slots to open, which, in turn, gave rise to aileron snatching and completely ruined sighting on any aircraft being attacked, a shortcoming inherited from preceding versions of the Bf 109.

Another inherited shortcoming was the lack of any rudder trimming device, necessitating the application of moderate right rudder during the climb and considerable left rudder during a dive. Thus, although *Gustav* pilots tended to use a bunt into a steep dive as an escape manœuvre during dogfights, they had some very heavy rudder and elevator control forces to contend with as speed built up, and pull-outs at low altitude had to be made with considerable circumspection. This manœuvre was employed against earlier marks of Spitfire and Hurricane which could not follow without their Merlin engine cutting in the bunt, but with the availability of the negative-*g* carburettor, some RAF pilots, finding a Messerschmitt on their tail, took to deliberately diving to ground level in an attempt to lure their antagonist to disaster.

At its rather disappointingly low-level cruise of 240 mph (386 km/h), *Gustav* was certainly delightful to fly, but the situation changed as speed increased. In a dive at 400 mph (644 km/h) the controls felt as though they had seized up! The highest speed that I dived to below 10,000 ft (3 050 m) was 440 mph (708 km/h) and the solidity of control was such that this was the limit in my book. However, things were different at altitude, and providing that *Gustav* was kept where it was meant to be – way up high – it performed very efficiently, both in dogfighting and as an attacker of bomber formations. To give some idea of its performance, I clocked 384 mph (618 km/h) in level flight at 23,000 ft (7 010 m), which conformed pretty well with the officially-claimed Vmax of 386 mph (621 km/h) at 22,640 ft (6 900 m).

I was particularly interested in the operation of the slots, the action of which gave rise to aileron snatching in any high-*g* manœuvres, a shortcoming characteristic of all versions of the Bf 109. In a series of stalls to check the functioning of the slots more accurately, I found that with the aircraft clean, a half fuel load and the engine throttled right back, the stall occurred at 105 mph (169 km/h), this being preceded by elevator buffet and the opening of the slots about 20 mph (30 km/h) above the stall. There was unpleasant aileron snatching as the slots opened unevenly, but the stall itself was fairly gentle with the nose dropping about 10 degrees simultaneously. In the landing configuration the stall occurred at 99 mph (159 km/h) with identical symptoms apart from heavier elevator buffeting.

Formidable Anti-bomber Weapon

A number of dummy attacks on a co-operative Lancaster and a friendly skirmish with a Mustang flown by one of the RAE pilots revealed the fact that the slipstream of these aircraft caused the intermittent operation of *Gustav*'s slots so that accurate sighting became something of a nightmare. The Mustang III displayed a clear speed advantage at all altitudes, this ranging from around 30 mph (48 km/h) at the Bf 109G-6's rated altitude to some 50 mph (80 km/h) at 30,000 ft (9 145 m), but the German fighter had a marginally better climb rate up to 20,000 ft (6 095 m), the Mustang being at a slight advantage between this altitude and 25,000 ft (7 620 m). When dived and then pulled up into a climb there was little to choose between the two, but the Mustang could steadily outdive *Gustav* and could out-turn it with no difficulty. Of course, in making a direct comparison between the Messerschmitt and the North American fighter, it should be remembered that the former came a generation behind the latter, yet *Gustav* still stood up pretty well to the competition.

If no longer a *great* fighter-versus-fighter aeroplane by the time that the basic design had reached the G-series, Messerschmitt's Bf 109 was still a sound all-rounder and *Gustav* had greater flexibility from some aspects than preceding sub-types. Allied bomber formations were certainly finding the Bf 109G a formidable antagonist and its pilots must, therefore, have evolved means of countering the disconcerting habit of the slots to pop open and shut in the slipstreams of their quarries. There was no gainsaying that *Gustav* presented a very small target profile to the bomber's gunners; it possessed heavy firepower and it offered a more than reasonable overtaking speed.

In landing *Gustav*, the approach was steeper than that of the Spitfire, but elevator feel was very positive and gave delightfully accurate control at 118 mph (190 km/h). A substantial change of attitude was called for on the flare or round-out before touchdown, and even after ground contact the lift did not spill rapidly, and ballooning or bouncing could easily be experienced on rough ground. Once the tailwheel was firmly on the ground the brakes could be applied quite harshly, thus giving a short landing run, but care had to be taken to prevent any swing as the combination of narrow-track undercarriage and minimal forward view could well result in directional problems.

I may have dwelt overly on the negative characteristics of the Bf 109, but it should be remembered that my introduction to the Messerschmitt fighter came late in its operational career when it had been overtaken in some respects by succeeding generations of fighters. Even at that late stage, however, comparison reflected no

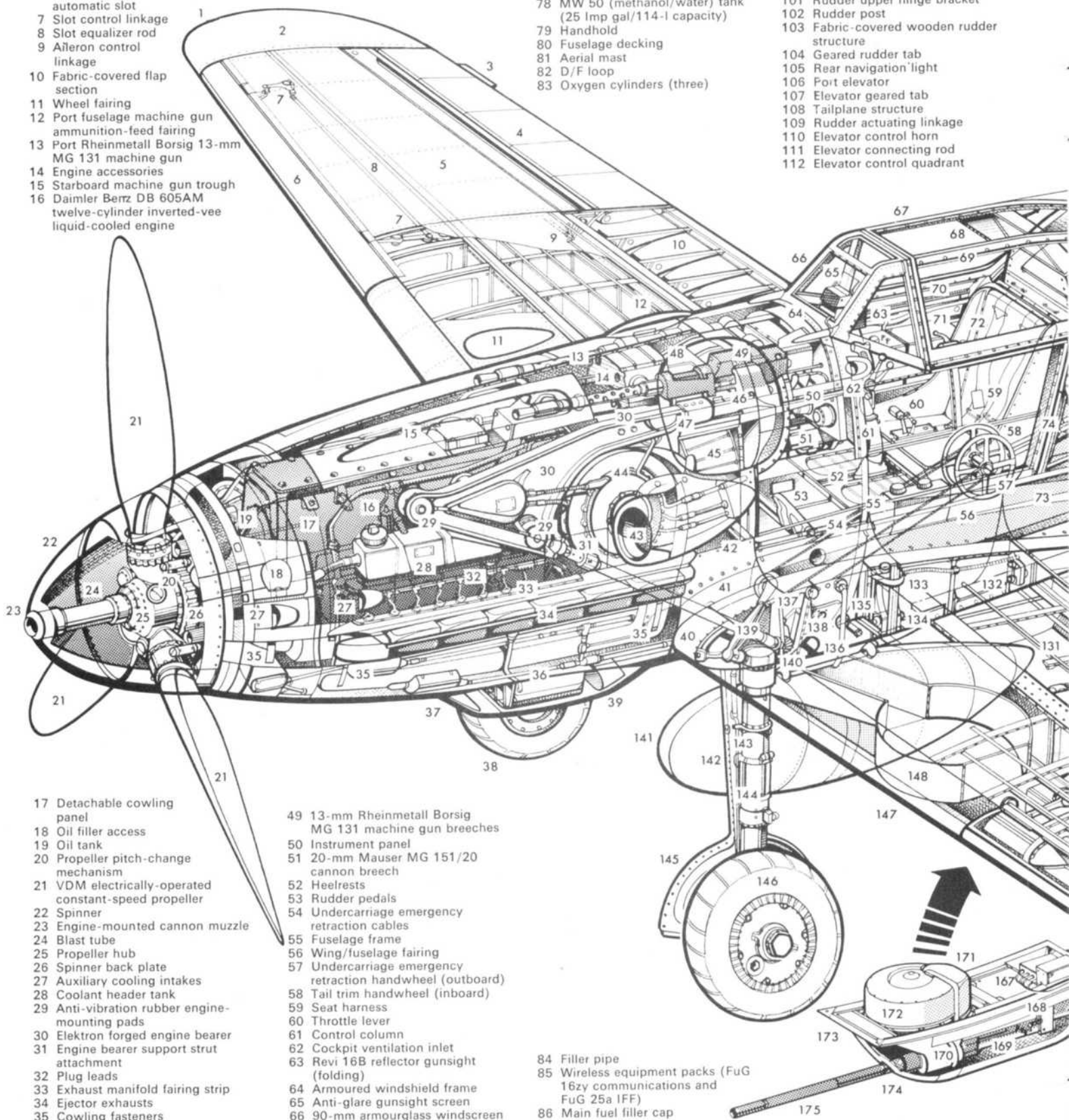
Messerschmitt Bf 109G-14/U4 Cutaway Drawing Key

1 Starboard navigation light
2 Starboard wingtip
3 Fixed trim tab
4 Starboard Frise-type aileron
5 Flush-riveted stressed wing-skinning
6 Handley Page leading-edge automatic slot
7 Slot control linkage
8 Slot equalizer rod
9 Aileron control linkage
10 Fabric-covered flap section
11 Wheel fairing
12 Port fuselage machine gun ammunition-feed fairing
13 Port Rheinmetall Borsig 13-mm MG 131 machine gun
14 Engine accessories
15 Starboard machine gun trough
16 Daimler Benz DB 605AM twelve-cylinder inverted-vee liquid-cooled engine

45 20-mm cannon magazine drum
46 13-mm machine gun ammunition feed
47 Engine bearer upper attachment
48 Ammunition feed fairing

73 Underfloor contoured fuel tank (88 Imp gal/400 litre of 87 octane B4)
74 Fuselage frame
75 Circular access panel
76 Tail trimming cable conduit
77 Wireless leads
78 MW 50 (methanol/water) tank (25 Imp gal/114-l capacity)
79 Handhold
80 Fuselage decking
81 Aerial mast
82 D/F loop
83 Oxygen cylinders (three)

94 Tailfin root fairing
95 Starboard fixed tailplane
96 Elevator balance
97 Starboard elevator
98 Geared elevator tab
99 All-wooden tailfin construction
100 Aerial attachment
101 Rudder upper hinge bracket
102 Rudder post
103 Fabric-covered wooden rudder structure
104 Geared rudder tab
105 Rear navigation light
106 Port elevator
107 Elevator geared tab
108 Tailplane structure
109 Rudder actuating linkage
110 Elevator control horn
111 Elevator connecting rod
112 Elevator control quadrant

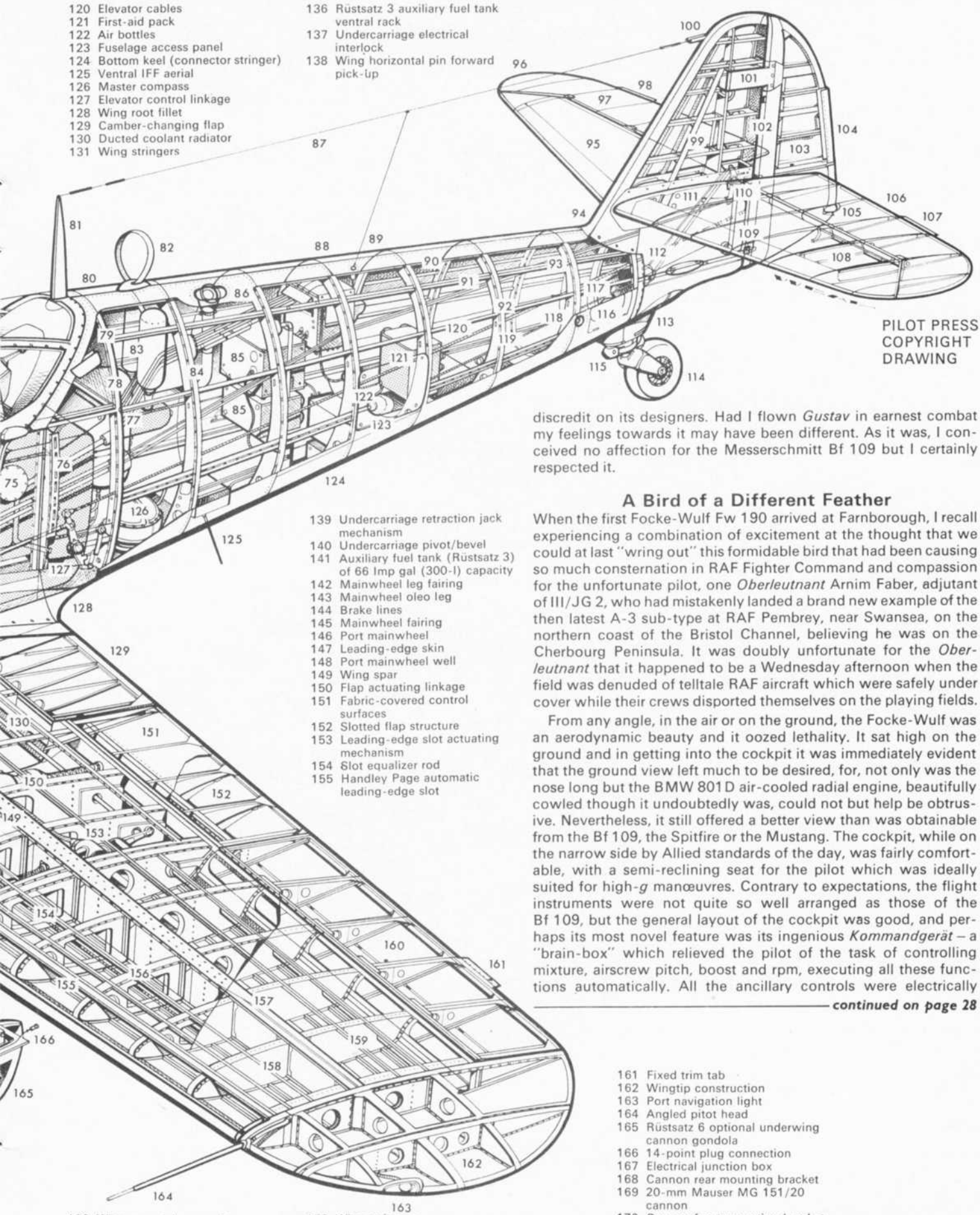


17 Detachable cowling panel
18 Oil filler access
19 Oil tank
20 Propeller pitch-change mechanism
21 VDM electrically-operated constant-speed propeller
22 Spinner
23 Engine-mounted cannon muzzle
24 Blast tube
25 Propeller hub
26 Spinner back plate
27 Auxiliary cooling intakes
28 Coolant header tank
29 Anti-vibration rubber engine-mounting pads
30 Elektron forged engine bearer
31 Engine bearer support strut attachment
32 Plug leads
33 Exhaust manifold fairing strip
34 Ejector exhausts
35 Cowling fasteners
36 Oil cooler
37 Oil cooler intake
38 Starboard mainwheel
39 Oil cooler outlet flap
40 Wing root fillet
41 Wing/fuselage fairing
42 Firewall/bulkhead
43 Supercharger air intake
44 Supercharger assembly

49 13-mm Rheinmetall Borsig MG 131 machine gun breeches
50 Instrument panel
51 20-mm Mauser MG 151/20 cannon breech
52 Heelrests
53 Rudder pedals
54 Undercarriage emergency retraction cables
55 Fuselage frame
56 Wing/fuselage fairing
57 Undercarriage emergency retraction handwheel (outboard)
58 Tail trim handwheel (inboard)
59 Seat harness
60 Throttle lever
61 Control column
62 Cockpit ventilation inlet
63 Revi 16B reflector gunsight (folding)
64 Armoured windshield frame
65 Anti-glare gunsight screen
66 90-mm armourglass windscreen
67 "Galland"-type clear-vision hinged canopy
68 Framed armourglass head/back panel
69 Canopy contoured frame
70 Canopy hinges (starboard)
71 Canopy release catch
72 Pilot's bucket-type seat (8-mm back armour)

84 Filler pipe
85 Wireless equipment packs (FuG 16zy communications and FuG 25a IFF)
86 Main fuel filler cap
87 Aerial
88 Fuselage top keel (connector stringer)
89 Aerial lead-in
90 Fuselage skin plating sections
91 'U'-stringers
92 Fuselage frames (monocoque construction)
93 Tail trimming cables

113 Tailwheel leg cuff
114 Castoring non-retractable tailwheel
115 Lengthened tailwheel leg
116 Access panel
117 Tailwheel shock-strut
118 Lifting point
119 Rudder cable



120 Elevator cables
121 First-aid pack
122 Air bottles
123 Fuselage access panel
124 Bottom keel (connector stringer)
125 Ventral IFF aerial
126 Master compass
127 Elevator control linkage
128 Wing root fillet
129 Camber-changing flap
130 Ducted coolant radiator
131 Wing stringers
136 Rüstsatz 3 auxiliary fuel tank ventral rack
137 Undercarriage electrical interlock
138 Wing horizontal pin forward pick-up
139 Undercarriage retraction jack mechanism
140 Undercarriage pivot/bevel
141 Auxiliary fuel tank (Rüstsatz 3) of 66 Imp gal (300-l) capacity
142 Mainwheel leg fairing
143 Mainwheel oleo leg
144 Brake lines
145 Mainwheel fairing
146 Port mainwheel
147 Leading-edge skin
148 Port mainwheel well
149 Wing spar
150 Flap actuating linkage
151 Fabric-covered control surfaces
152 Slotted flap structure
153 Leading-edge slot actuating mechanism
154 Slot equalizer rod
155 Handley Page automatic leading-edge slot
132 Wing rear pick-up point
133 Spar/fuselage upper pin joint (horizontal)
134 Spar/fuselage lower pin joint (vertical)
135 Flaps equalizer rod
156 Wing stringers
157 Spar flange decrease
158 Wing ribs
159 Flush-riveted stressed wing-skinning
160 Metal-framed Frise-type aileron
161 Fixed trim tab
162 Wingtip construction
163 Port navigation light
164 Angled pitot head
165 Rüstsatz 6 optional underwing cannon gondola
166 14-point plug connection
167 Electrical junction box
168 Cannon rear mounting bracket
169 20-mm Mauser MG 151/20 cannon
170 Cannon front mounting bracket
171 Ammunition feed chute
172 Ammunition magazine drum
173 Underwing panel
174 Gondola fairing
175 Cannon barrel

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discredit on its designers. Had I flown *Gustav* in earnest combat my feelings towards it may have been different. As it was, I conceived no affection for the Messerschmitt Bf 109 but I certainly respected it.

A Bird of a Different Feather

When the first Focke-Wulf Fw 190 arrived at Farnborough, I recall experiencing a combination of excitement at the thought that we could at last "wring out" this formidable bird that had been causing so much consternation in RAF Fighter Command and compassion for the unfortunate pilot, one *Oberleutnant* Arnim Faber, adjutant of III/JG 2, who had mistakenly landed a brand new example of the then latest A-3 sub-type at RAF Pembrey, near Swansea, on the northern coast of the Bristol Channel, believing he was on the Cherbourg Peninsula. It was doubly unfortunate for the *Oberleutnant* that it happened to be a Wednesday afternoon when the field was denuded of telltale RAF aircraft which were safely under cover while their crews disported themselves on the playing fields.

From any angle, in the air or on the ground, the Focke-Wulf was an aerodynamic beauty and it oozed lethality. It sat high on the ground and in getting into the cockpit it was immediately evident that the ground view left much to be desired, for, not only was the nose long but the BMW 801D air-cooled radial engine, beautifully cowled though it undoubtedly was, could not but help be obtrusive. Nevertheless, it still offered a better view than was obtainable from the Bf 109, the Spitfire or the Mustang. The cockpit, while on the narrow side by Allied standards of the day, was fairly comfortable, with a semi-reclining seat for the pilot which was ideally suited for high-*g* manœuvres. Contrary to expectations, the flight instruments were not quite so well arranged as those of the Bf 109, but the general layout of the cockpit was good, and perhaps its most novel feature was its ingenious *Kommandgerät* – a "brain-box" which relieved the pilot of the task of controlling mixture, airscrew pitch, boost and rpm, executing all these functions automatically. All the ancillary controls were electrically

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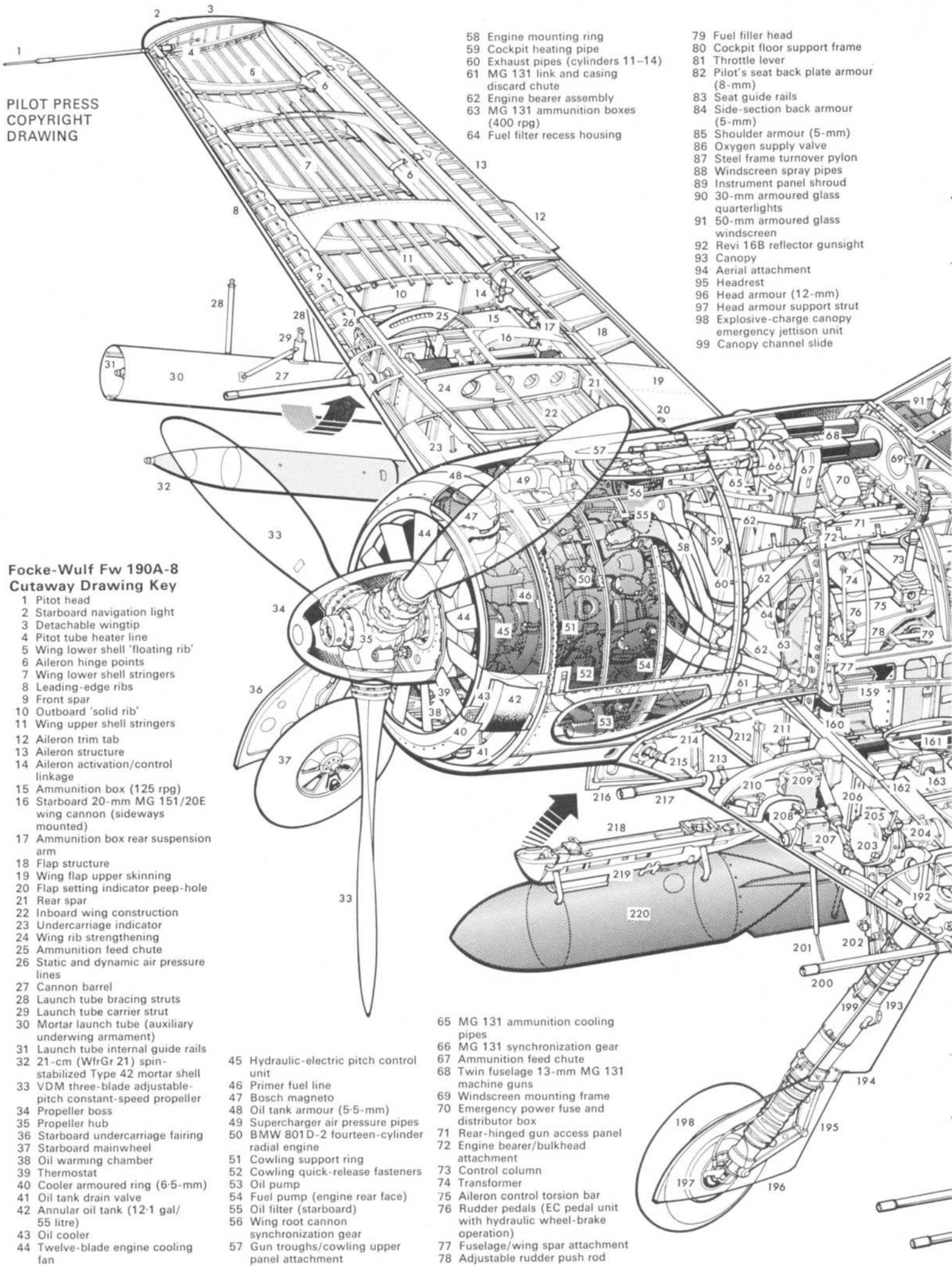

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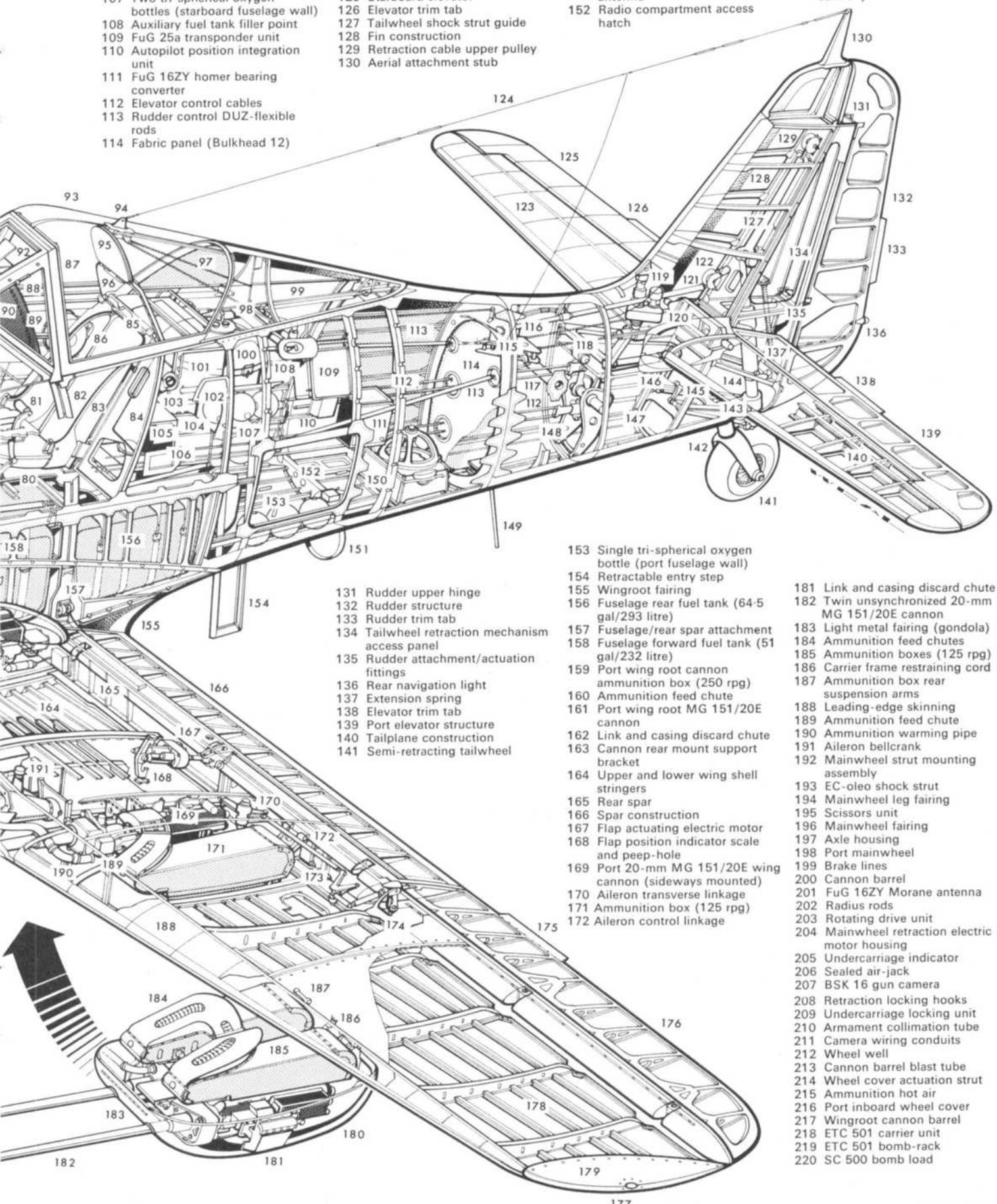
DRAWING

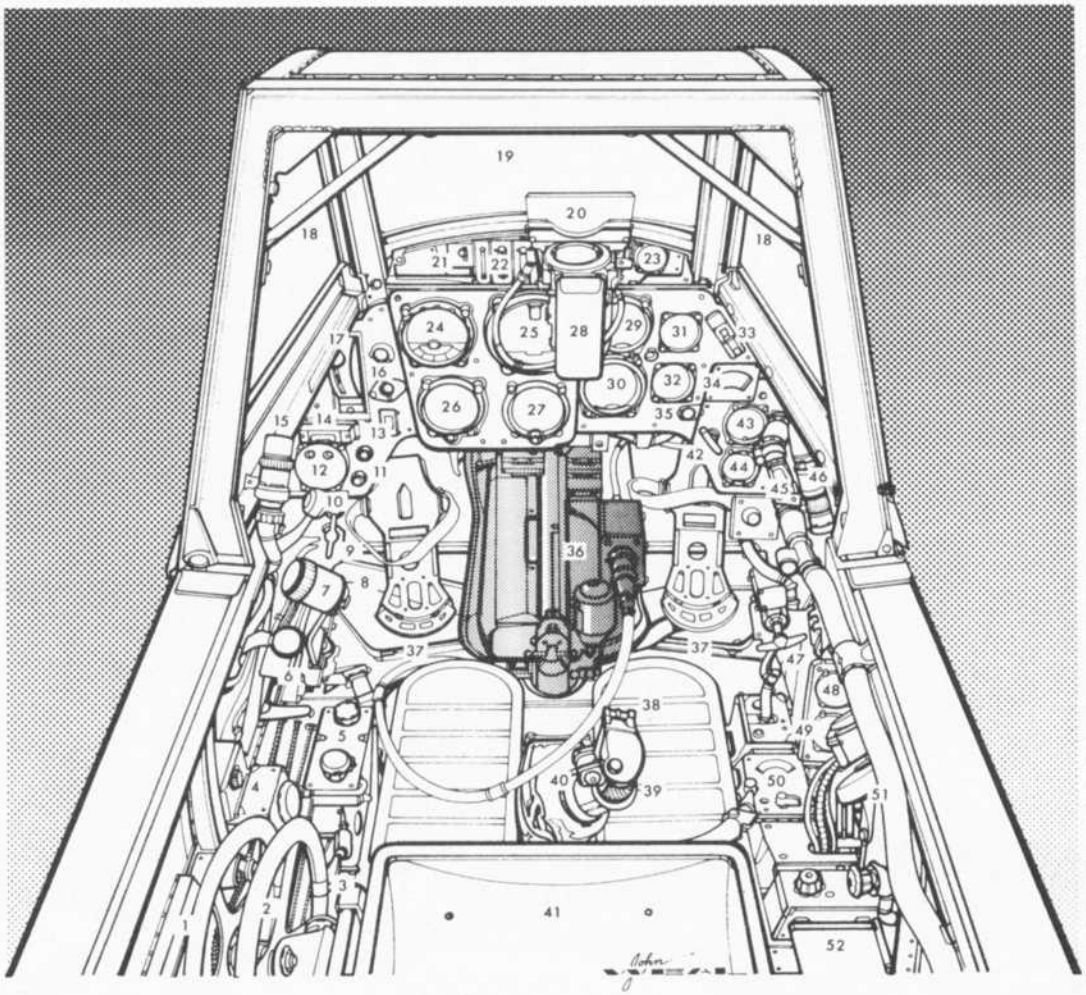
Focke-Wulf Fw 190A-8 Cutaway Drawing Key

1 Pitot head
2 Starboard navigation light
3 Detachable wingtip
4 Pitot tube heater line
5 Wing lower shell 'floating rib'
6 Aileron hinge points
7 Wing lower shell stringers
8 Leading-edge ribs
9 Front spar
10 Outboard 'solid rib'
11 Wing upper shell stringers
12 Aileron trim tab
13 Aileron structure
14 Aileron activation/control linkage
15 Ammunition box (125 rpg)
16 Starboard 20-mm MG 151/20E wing cannon (sideways mounted)
17 Ammunition box rear suspension arm
18 Flap structure
19 Wing flap upper skinning
20 Flap setting indicator peep-hole
21 Rear spar
22 Inboard wing construction
23 Undercarriage indicator
24 Wing rib strengthening
25 Ammunition feed chute
26 Static and dynamic air pressure lines
27 Cannon barrel
28 Launch tube bracing struts
29 Launch tube carrier strut
30 Mortar launch tube (auxiliary underwing armament)
31 Launch tube internal guide rails
32 21-cm (WfrGr 21) spin-stabilized Type 42 mortar shell
33 VDM three-blade adjustable-pitch constant-speed propeller
34 Propeller boss
35 Propeller hub
36 Starboard undercarriage fairing
37 Starboard mainwheel
38 Oil warming chamber
39 Thermostat
40 Cooler armoured ring (6·5-mm)
41 Oil tank drain valve
42 Annular oil tank (12·1 gal/55 litre)
43 Oil cooler
44 Twelve-blade engine cooling fan
45 Hydraulic-electric pitch control unit
46 Primer fuel line
47 Bosch magneto
48 Oil tank armour (5·5-mm)
49 Supercharger air pressure pipes
50 BMW 801D-2 fourteen-cylinder radial engine
51 Cowling support ring
52 Cowling quick-release fasteners
53 Oil pump
54 Fuel pump (engine rear face)
55 Oil filter (starboard)
56 Wing root cannon synchronization gear
57 Gun troughs/cowling upper panel attachment
58 Engine mounting ring
59 Cockpit heating pipe
60 Exhaust pipes (cylinders 11–14)
61 MG 131 link and casing discard chute
62 Engine bearer assembly
63 MG 131 ammunition boxes (400 rpg)
64 Fuel filter recess housing
65 MG 131 ammunition cooling pipes
66 MG 131 synchronization gear
67 Ammunition feed chute
68 Twin fuselage 13-mm MG 131 machine guns
69 Windscreen mounting frame
70 Emergency power fuse and distributor box
71 Rear-hinged gun access panel
72 Engine bearer/bulkhead attachment
73 Control column
74 Transformer
75 Aileron control torsion bar
76 Rudder pedals (EC pedal unit with hydraulic wheel-brake operation)
77 Fuselage/wing spar attachment
78 Adjustable rudder push rod
79 Fuel filler head
80 Cockpit floor support frame
81 Throttle lever
82 Pilot's seat back plate armour (8-mm)
83 Seat guide rails
84 Side-section back armour (5-mm)
85 Shoulder armour (5-mm)
86 Oxygen supply valve
87 Steel frame turnover pylon
88 Windscreen spray pipes
89 Instrument panel shroud
90 30-mm armoured glass quarterlights
91 50-mm armoured glass windscreen
92 Revi 16B reflector gunsight
93 Canopy
94 Aerial attachment
95 Headrest
96 Head armour (12-mm)
97 Head armour support strut
98 Explosive-charge canopy emergency jettison unit
99 Canopy channel slide



100 Auxiliary tank : fuel (25·3 gal/115 litre) or GM-1 (18·7 gal/85 litre)
101 FuG 16ZY transmitter-receiver unit
102 Handhold cover
103 Primèr fuel filler cap
104 Autopilot steering unit (PKS 12)
105 FuG 16ZY power transformer
106 Entry step cover plate
107 Two tri-spherical oxygen bottles (starboard fuselage wall)
108 Auxiliary fuel tank filler point
109 FuG 25a transponder unit
110 Autopilot position integration unit
111 FuG 16ZY homer bearing converter
112 Elevator control cables
113 Rudder control DUZ-flexible rods
114 Fabric panel (Bulkhead 12)
115 Rudder differential unit
116 Aerial lead-in
117 Rear fuselage lift tube
118 Triangular stress frame
119 Tailplane trim unit
120 Tailplane attachment fitting
121 Tailwheel retraction guide tube
122 Retraction cable lower pulley
123 Starboard tailplane
124 Aerial
125 Starboard elevator
126 Elevator trim tab
127 Tailwheel shock strut guide
128 Fin construction
129 Retraction cable upper pulley
130 Aerial attachment stub
131 Rudder upper hinge
132 Rudder structure
133 Rudder trim tab
134 Tailwheel retraction mechanism access panel
135 Rudder attachment/actuation fittings
136 Rear navigation light
137 Extension spring
138 Elevator trim tab
139 Port elevator structure
140 Tailplane construction
141 Semi-retracting tailwheel
142 Forked wheel housing
143 Drag yoke
144 Tailwheel shock strut
145 Tailwheel locking linkage
146 Elevator actuation lever linkage
147 Angled frame spar
148 Elevator differential bellcrank
149 FuG 25a ventral antenna
150 Master compass sensing unit
151 FuG 16ZY fixed loop homing antenna
152 Radio compartment access hatch
153 Single tri-spherical oxygen bottle (port fuselage wall)
154 Retractable entry step
155 Wingroot fairing
156 Fuselage rear fuel tank (64·5 gal/293 litre)
157 Fuselage/rear spar attachment
158 Fuselage forward fuel tank (51 gal/232 litre)
159 Port wing root cannon ammunition box (250 rpg)
160 Ammunition feed chute
161 Port wing root MG 151/20E cannon
162 Link and casing discard chute
163 Cannon rear mount support bracket
164 Upper and lower wing shell stringers
165 Rear spar
166 Spar construction
167 Flap actuating electric motor
168 Flap position indicator scale and peep-hole
169 Port 20-mm MG 151/20E wing cannon (sideways mounted)
170 Aileron transverse linkage
171 Ammunition box (125 rpg)
172 Aileron control linkage
173 Ammunition box rear suspension arm
174 Aileron control unit
175 Aileron trim tab
176 Port aileron structure
177 Port navigation light
178 Outboard wing stringers
179 Detachable wingtip
180 A-8/R1 variant underwing gun pack (in place of outboard wing cannon)
181 Link and casing discard chute
182 Twin unsynchronized 20-mm MG 151/20E cannon
183 Light metal fairing (gondola)
184 Ammunition feed chutes
185 Ammunition boxes (125 rpg)
186 Carrier frame restraining cord
187 Ammunition box rear suspension arms
188 Leading-edge skinning
189 Ammunition feed chute
190 Ammunition warming pipe
191 Aileron bellcrank
192 Mainwheel strut mounting assembly
193 EC-oleo shock strut
194 Mainwheel leg fairing
195 Scissors unit
196 Mainwheel fairing
197 Axle housing
198 Port mainwheel
199 Brake lines
200 Cannon barrel
201 FuG 16ZY Morane antenna
202 Radius rods
203 Rotating drive unit
204 Mainwheel retraction electric motor housing
205 Undercarriage indicator
206 Sealed air-jack
207 BSK 16 gun camera
208 Retraction locking hooks
209 Undercarriage locking unit
210 Armament collimation tube
211 Camera wiring conduits
212 Wheel well
213 Cannon barrel blast tube
214 Wheel cover actuation strut
215 Ammunition hot air
216 Port inboard wheel cover
217 Wingroot cannon barrel
218 ETC 501 carrier unit
219 ETC 501 bomb-rack
220 SC 500 bomb load

Messerschmitt Bf 109G-6 Cockpit Instrumentation Key



1 Undercarriage emergency lowering handwheel
2 Tailplane trim wheel
3 Seat height adjustment handle
4 Tailplane incidence indicator panel
5 Fuel injection primer pump
6 Fuel cock lever
7 Throttle
8 Throttle-mounted propeller pitch control thumbswitch
9 Dust filter handgrip
10 Canopy lever
11 Undercarriage switches
12 Undercarriage position indicators
13 Start plug cleansing switch
14 Starter switch
15 Panel light
16 Main light switch
17 Ignition switch
18 Frame struts
19 Armour glass windscreen
20 Revi 16B reflector gunsight
21 Armament switch
22 Ammunition counters
23 Clock
24 Repeater compass
25 Artificial horizon/turn-and-bank indicator
26 Fine and coarse altimeter
27 Airspeed indicator
28 Gunsight padding
29 Manifold pressure gauge
30 Tachometer
31 AFN 2 homing indicator (FuG 16ZY)
32 Mechanical propeller pitch position indicator
33 Tumbler switch
34 Combined coolant exit and oil intake temperature indicator
35 Fuel warning lamp
36 30-mm MK 108 cannon breech
37 Rudder pedals
38 Firing trigger
39 Gun charging knob
40 Control column
41 Pilot's seat
42 Undercarriage emergency release
43 Electric fuel contents gauge
44 Dual oil and fuel pressure gauge
45 Auxiliary fuel contents indicator
46 Panel light
47 Coolant radiator control
48 Oxygen supply indicator
49 Oxygen pressure gauge
50 Radio switch panel
51 Oxygen supply
52 Radio tuner panel

operated by a mass of pushbuttons which were obviously intended for daintily-gloved fingers and not for the massive leather flying gauntlets issued to British aircrew and which converted the human hand into a bunch of bananas.

My first experience of flying Kurt Tank's formidable fighter was gained not with *Oberleutnant* Faber's Fw 190A-3 but with an Fw 190A-4 that had also been landed by its pilot in error at an RAF field, this event having taken place at West Malling almost a year later, on 17 April 1943, and the aircraft reaching Farnborough three days later as PE882.

Starting was by inertia starter energised by a 24-volt external battery or by the aircraft's own battery. The engine had to be primed internally, both fuel tanks and pumps selected ON and the cooling gills set one-third open. The BMW 801D usually fired first time and emitted a smooth purr as it ran. Once one had familiarised oneself with the self-centering tailwheel, taxying was easy as the Focke-Wulf could be swung freely from side to side on its wide-track undercarriage and the brakes were good. After lining up for take-off, the stick was moved to an aft position in order to lock the tailwheel, flaps were lowered 10 degrees and elevator trimmer set neutral, and propeller pitch was set to AUTO. On opening up the engine there was some tendency to swing to port, but this could easily be held on the rudder. Using 2,700 rpm and 1·6 *atas* (23·5 lb) boost, the run proved to be much the same as that of the Spitfire IX. Unstick speed was 112 mph (180 km/h) and after retracting the undercarriage, the boost was reduced to 1·45 *atas* and at 143 mph (230 km/h) the flaps were raised. A climbing speed of 161 mph (260 km/h) was then set up, using 2,500 rpm to give a climb rate of 3,150 ft/min (16 m/sec).

The most impressive feature of the Focke-Wulf was its beautifully light ailerons and high rate of roll. The ailerons maintained their lightness from the stall up to 400 mph (644 km/h), although they heavied up above that speed. There was no aileron trimmer in the cockpit, and if the external adjustable trim tab had been altered by groundcrew inadvertently pushing on it, for example, it was possible to get an out-of-trim force of considerable proportions at high speed. The elevators were heavy at all speeds and particularly so above 350 mph (563 km/h) when they became heavy enough to impose a tactical restriction on the aircraft as regards pull-out from low-level dives. This heaviness was accentuated because of the nose down pitch which occurred at high speeds when trimmed for low speeds. The critical speed at which this change in trim occurred was around 220 mph (354 km/h) and could be easily gauged in turns. At lower speeds the Focke-Wulf tended to tighten up the turn and a slight forward pressure on the stick had to be applied, but above that figure the changeover called for some backward pressure to hold the aircraft in the turn.

Harmony of Control

Rudder control was positive and effective at low speeds, and satisfactory at high speeds when it seldom had to be used for any normal manœuvre. It was when one took the three controls together rather than in isolation that one realised that the Fw 190's magic as a fighter lay in its superb harmony of control. To be a good dogfighter and, at the same time, a good gun platform required just those very characteristics that the Focke-Wulf possessed in all important matters of stability and control. The stability was very good directionally, unstable laterally and neutral longitudinally at the normal cruise of 330 mph (530 km/h) at 8,000 ft (2 440 m). There is, of course, always some penalty invoked by such handling attributes and in the Fw 190's case it was that the aircraft was not at all easy to fly on instruments, but then its sole *raison d'être* at the time of its creation was *day* fighting. It is significant that all-weather versions were fitted with an autopilot.

The top speed of the Fw 190A-4 was checked and was found to be 394 mph (634 km/h) at 18,500 ft (5 640 m), and its service ceiling was about 35,000 ft (10 670 m), so it matched the Spitfire IX almost mile per hour and foot per foot of ceiling. With virtually

Photograph by Arthur Gibson

FIRST WITH THE ACTION

DAILY EXPRESS

Blériot crossed the Channel in 35 minutes in 1909. Concorde can cross the Atlantic in only three hours.

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the same armament here were two aircraft so evenly matched that the skill of the pilot became the vital factor in combat supremacy. Skill in aerial combat does, however, mean flying an aircraft to its limits, not only of performance but of handling, and when the performance of the enemy is equal to one's own, then handling characteristics become vital in seeking an advantage. The Focke-Wulf had one big advantage over the Spitfire IX in that it possessed a higher rate of roll, but the German fighter also had its Achilles heel in harsh stalling characteristics which limited its manœuvre margins.

The stalling speed of the Fw 190A-4 in clean configuartion occurred at 127 mph (204 km/h), and the stall came suddenly and practically without warning, the port wing dropping so violently that the aircraft almost inverted itself. Indeed, if the Focke-Wulf was pulled into a *g* stall in a tight turn, it would flick out into the opposite bank and an incipient spin was the inevitable outcome if the pilot did not have his wits about him. The stall in landing configuration was quite different, there being intense pre-stall buffeting before the starboard wing dropped comparatively gently at 102 mph (164 km/h).

For landing I usually lowered the undercarriage at 186 mph (300 km/h), lowering the flaps 10 degrees at 168 mph (270 km/h), although the German Pilot's Notes recommended reducing speed below 155 mph (250 km/h) and then applying 10 degrees of flap prior to lowering the undercarriage. My reason for departing from the recommended drill was that the electrical load for lowering the undercarriage was higher than that required for the flaps, and German batteries were in somewhat short supply – that in our Fw 190A-4 was decidedly weary – so I felt it prudent to get the wheels down before taxing the strength of the battery further.

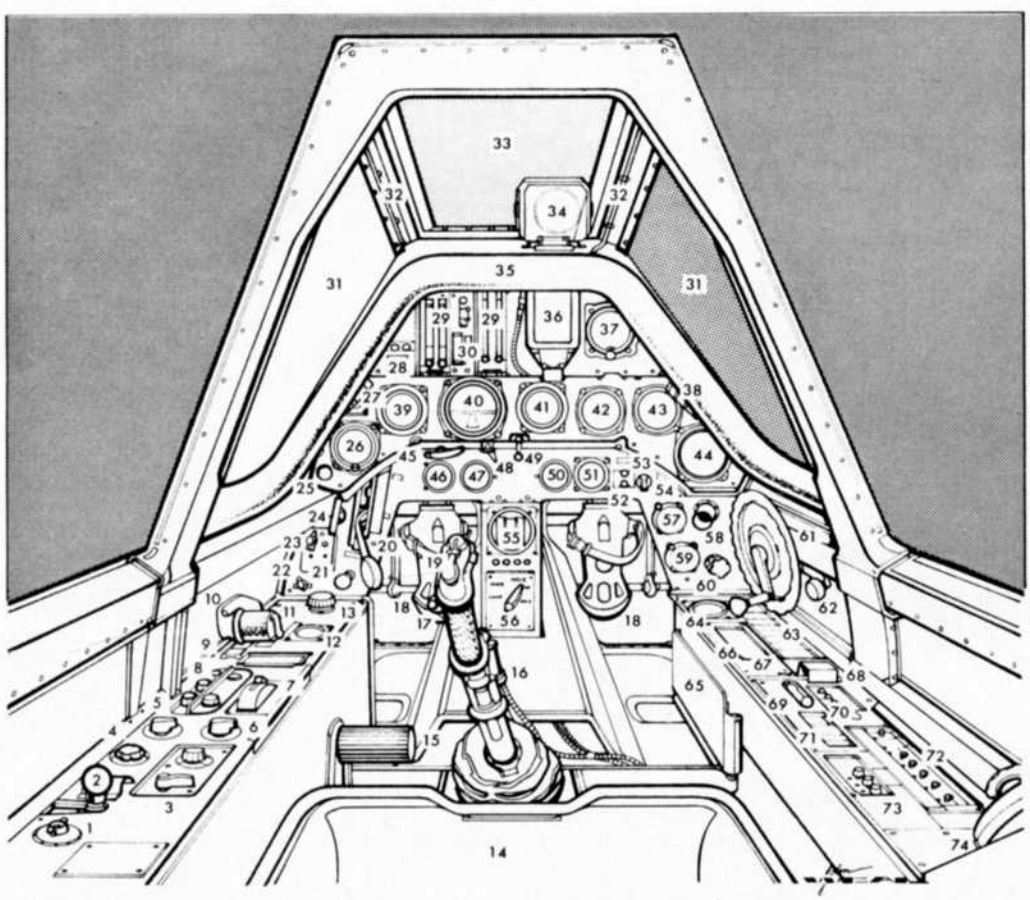
The turn onto final approach was made at 155 mph (250 km/h) and full flap was applied at 149 mph (240 km/h), speed then being eased off to cross the boundary at 124 mph (200 km/h). The view on the approach was poor because the attitude with power on was rather flat, and unlike most fighters of that time, it was not permitted to open the cockpit canopy, presumably owing to the risk of engine exhaust fumes entering the cockpit. The actual touchdown was quite tricky because a perfect three-point attitude was difficult to attain and anything less than perfect produced a reaction from the very non-resilient undercarriage and a very bouncy arrival. However, if a three-pointer *was* achieved, the landing run was short and the brakes could be applied harshly without fear of nosing over.

I flew the Fw 190 many times and several varieties of the breed, and each time I experienced that sense of exhilaration that came from flying an aircraft that one instinctively knew to be a top-notcher, but, at the same time, demanded handling skill if its high qualities were to be exploited. Just as the Spitfire IX was probably the most outstanding British fighter aircraft to give service in WW II, its Teutonic counterpart undoubtedly deserves the same recognition for Germany. Both were supreme in their time and their class; both were durable and technically superb, and if each had not been there to counter the other, then the balance of air power could have been dramatically altered at a crucial period in the fortunes of both combatants.

Both Fw 190 and Bf 109 were truly great aircraft in their day; they possessed their own intrinsic and distinctive merits and, like all fighters, they also had their shortcomings, but both must surely stand high in the world ranking list of fighters in the annals of military aviation.

Focke-Wulf 190A-8 Cockpit Instrumentation Key

1 Helmet R/T connection
2 Primer fuel pump handle
3 FuG 16ZY communications and homing switch and volume control
4 FuG 16ZY receiver fine tuning
5 FuG 16ZY homing range switch
6 FuG 16ZY frequency selector switch
7 Tailplane trim switch
8 Undercarriage and landing flap actuation buttons
9 Undercarriage and landing flap position indicators
10 Throttle
11 Throttle-mounted propeller pitch control thumbswitch
12 Tailplane trim indicator
13 Instrument panel lighting dimmer
14 Pilot's seat
15 Throttle friction knob
16 Control column
17 Bomb release button
18 Rudder pedals
19 Wing gun firing button
20 Fuel tank selector lever
21 Engine starter brushes withdrawal button
22 Stop cock control lever
23 FuG 25a IFF control panel
24 Undercarriage manual lowering handle
25 Cockpit ventilation knob
26 Altimeter
27 Pitot tube heater light
28 MG 131 "armed" indicator lights
29 Ammunition counters
30 SZKK 4 armament switch and control panel
31 30-mm armour glass quarter lights
32 Windscreen spray pipes
33 50-mm armour glass
34 Revi 16B reflector gunsight
35 Padded coaming
36 Gunsight padded mounting
37 AFN 2 homing indicator (FuG 16ZY)
38 Ultra-violet lights (port and starboard)
39 Airspeed indicator
40 Artificial horizon
41 Rate of climb/descent indicator
42 Repeater compass
43 Supercharger pressure gauge
44 Tachometer
45 Ventral stores manual release
46 Fuel and oil pressure gauge
47 Oil temperature gauge
48 Windscreen washer operating lever
49 Engine ventilation flap control lever
50 Fuel contents gauge
51 Propeller pitch indicator
52 Rear fuel tank switchover light (white)
53 Fuel contents warning light (red)
54 Fuel gauge selector switch
55 Underwing rocket (WGr 21) control panel
56 Bomb fusing selector panel and (above) external stores indicator lights
57 Oxygen flow indicator
58 Flare pistol holder
59 Oxygen pressure gauge
60 Oxygen flow valve
61 Canopy actuator drive
62 Canopy jettison lever
63 Circuit breaker panel cover
64 Clock
65 Map/chart holder
66 Operations data card
67 Flare box cover
68 Starter switch
69 Flare box cover plate release knob
70 Fuel pump circuit breakers
71 Compass deviation card
72 Circuit breaker panel cover
73 Armament circuit breakers
74 Oxygen supply



From Snipe to Nuclear Strike . . .

Derek Wood describes THE OBSERVERS' HALF-CENTURY

"TOCSIN 55 POST, Fourteen twenty-five, pressure one point five". In the event of any future war, this simple sentence, unintelligible to the uninitiated, relayed from some country village, would mean that a nuclear warhead had exploded on or over Britain.

The message would come from one of the 872 underground posts of the Royal Observer Corps, scattered the length and breadth of the country. Immediately, ROC and Home Office personnel at Group operations rooms would begin the task of assessing where the bomb had fallen and when and if deadly radio active fall-out might be expected from it. Teams of ROC members in the operations rooms of the Services would also be analysing the information flowing in from the Posts and Groups, enabling the Military commanders to see which areas would be affected.

As the deadly clouds of radio activity drifted across the country, each Post in turn would start reading its intensity and the warning would be given for everyone to stay under cover. At Sector Operations Rooms, attached to certain Groups, the scientists' predictions of the fall-out wave would be continuously revised, until radio activity had decayed to a safe level. Only then would the all-clear be sounded and those citizens not directly in the area of the burst be able to emerge and start re-building their lives.

This fearsome picture of the threat in the 'seventies is a far cry from the situation fifty-one years ago when France was the possible "enemy" and attack might only be from slow biplane bombers with small loads of high explosive. Yet it was in the summer of 1924 that a strange assortment of butchers, bakers and farmers were sworn in as Police Special Constables and first plotted a Sopwith Snipe fighter as it passed over mid-Kent.

In a make-shift operations room in the back of the Post Office of the small town of Cranbrook, a senior army officer stood looking at a map pinned to a table, on which other Special Constables were marking the progress of the flight with arrows and coloured plaques. Major-General E B Ashmore was no stranger to this sort of thing; he was a qualified pilot, had commanded a Royal Flying Corps Wing and in 1917–18 had been in charge of LADA, the London Air Defence Area.

Having proved his point at Cranbrook, Ashmore was able to go ahead with the formation of two Observer Groups to cover the South-East corner of England, No 1 with headquarters at Maidstone in Kent and No 2 with headquarters at Horsham in Sussex. These participated in their first air exercises in 1925 and, on October 29 of the same year, the establishment of the "Observer Corps" was officially approved by the Committee of Imperial Defence. The system was intended to provide the RAF and anti-aircraft commanders with a continuous overland picture of the air situation using Observer Posts linked in "clusters" to a "Centre" operations room. The plots gave estimated positions and the plotters round the map table were able to maintain attack. "Tellers" on a dais passed the information to the relevant RAF operations room. The Army ran the Corps, the RAF took the information and the recruiting was done by the County Chief Constables.

In 1926, two further Groups were formed, with headquarters based on Winchester and Colchester. There was no money for defence and little interest in the subject in the late 'twenties, and it was not until 1931 that a further Group was authorised – with its centre at Watford, Herts. In 1929, control of the Corps had passed from the War Office to the Air Ministry and a retired Air Commodore, E A D Masterman, was appointed as the first Commandant. The pace of the Corps was leisurely, with communications and plotting exercises held each year and visits made to RAF stations to look at, and fly in, such aeroplanes as were available. Aircraft recognition was not called for and it was possible to discover whether formations were supposed to be enemy only by studying the tracks and eliminating those of the friendly fighters that had been sent up.

With the growing threat of Hitlerite Germany, the need for more of the country to be covered by the Observer Corps became vital. Bombers were getting faster, carried heavier loads and could fly farther. It was now not only the Air Defence of Great Britain that wanted to know where the enemy might be but the Home Office as well, since, without proper observation and reporting, the air-raid sirens could not be sounded. From 1934, therefore, the pace quickened and Group after Group was set up, the operations rooms being positioned in or as near as possible to a main Post Office or Telephone Exchange. Administrative Areas were created to look after a number of Groups.

Each Group had a volunteer Controller who ran the operations room and, quite separately, an officer called the Observer Group Officer who, with his assistants, looked after the Posts. At each Post the man in charge was the "Head Special" with the rank of Police Sergeant. Originally, a rickety wooden sighting instrument called the "Heath Robinson" had been employed but in the thirties this was replaced by a metal machine on which the estimated height could be set up and the aircraft position read off to Centre. Later it was possible, by using the reports from two Posts, to give a corrected height. "Heard" plots were given on a circle line round

A typical ROC Monitoring Post with entrance hatch in the distance. The ventilator in the foreground carries a radio aerial. The protuberance sticking out of the grass in the middle is the cover for the ionisation chamber of the Fixed Survey Meter which measures the intensity of radio-active fall-out.

the Post.

In 1936, Fighter Command was formed at Bentley Priory and Air Marshal Sir Hugh Dowding arrived to command it. A key part of his reporting network was the Observer Corps under a new Commandant, Air Commodore A D Warrington Morris. Radar was in its infancy and was only intended to provide warning out to sea. As soon as a raider crossed the coast it was the responsibility of the Observer Corps to report it and track it. Sound locators were tested by the Corps but abandoned as being too complex and unreliable.

The Corps Goes to War

During the Munich crisis of 1938, the Corps was called out and all Posts and Centres were manned. When war did finally come on 3 September 1939, the whole Corps had been on duty day and night since 24 August. Officers were put into an RAF-type uniform but there was nothing for the ordinary Observers, except a Police brassard with "Observer Corps" printed on it, a tin helmet and a lapel badge. Because the RAF kept asking "what is it?", the Corps, of its own volition, decided to learn aircraft recognition. The first steps were taken in 1939, when a group of enthusiasts formed a "Hearkers" Club in Guildford, Surrey. They taught themselves to recognise aircraft and then taught others. It was not long before the idea snowballed and other groups of Observer Corps members up and down the country began to form Hearkers Clubs. Official recognition material of the period was poor and there was no official instruction, so private-venture Hearkers silhouette folders and cards were produced and standardised graded tests held. The national Hearkers Club became the Observer Corps Club and its amateur methods eventually formed the basis for Service recognition training.

Through the long winter months of 1939–40, the Observers watched, waited and froze. They thought the phoney war would never end. It was a breathing space, however, which allowed them to perfect their plotting techniques and streamline the tracking and telling from Observer Corps Centres of which there were, by 1940, no fewer than 32. Despite the lack of enemy aircraft there was plenty to do, plotting friendly aircraft, lighting paraffin flares to guide aircraft back to base, and reporting any unusual incidents, down to suspected spies and deserters on the run!

The real test, however, was not far off and after the evacuation from Dunkirk, the Battle of Britain was on. Through the summer months of July to October 1940, the Corps in the south and south-east of England worked unceasingly, passing millions of plots and providing the information on which overland interceptions could be made. Posts and Centres found themselves in the frontline, with bombs smashing huts and communication links, and bullets ricochet-ing off the rudimentary sandbag Post emplacements. In June, the Corps had been armed with rifles and many keen Observers took pot-shots at retreating Heinkels and Dorniers. The

In a modern ROC Centre: the positions of nuclear bursts are marked on vertical transparent screens and the likely radioactive fall-out plumes plotted. On the balcony beyond sit the Post Display Plotters who are connected by telephone to the underground Monitoring Posts. The Plotters receive information on nuclear bursts and fall-out, the five minute readings for the latter being marked on rotating boards.

Observer Corps also became one of the key elements in the invasion reporting network.

With the coming of autumn, the day battle merged into the night blitz. Every Group had its share of bombs, while in the heavy London and provincial city raids, one Observer Corps Centre was completely destroyed and another badly damaged. Despite everything the air picture was maintained, although on many occasions Centre map tables became completely saturated with the plots of hundreds of bombers coming in.

Royal Recognition

In recognition of its services to the nation over many years, and particularly during the Battle of Britain, King George VI, on 9 April 1941, granted the Corps the title "Royal", making it the only organisation of its kind during the war to be so honoured. In the following month, the Royal Observer Corps proved its worth yet again by correctly tracking and recognising the Messerschmitt Bf 110 flown by Rudolf Hess to Scotland. The RAF refused to believe it to be a Bf 110 until the wreckage was examined and the security authorities also refused to believe the ROC Group Officer who correctly identified the mysterious "Hauptmann Horn" as Hess.

In the recesses of Whitehall there were those who thought that with improvements in radar the days of the RAF's "Eyes and Ears" were now numbered. The inability to give adequate inland radar cover, and the German jamming of coastal radars, soon dispelled these ideas, however. The need for the Corps to be strengthened rather than abandoned was brought home in 1942–43 when southern England was plagued by "tip and run" raiders in the shape of Fw 190 and Bf 109 fighter-bombers, and only the Corps could give adequate warning to the RAF and to the local population. "Totter" signal rockets were installed at many Posts and satellite Posts were sited to fill the gaps in the low level coverage. Hedge-hopping raiders were given the code name "Rats" and this was to remain part of RAF/ROC language until the 1960s.

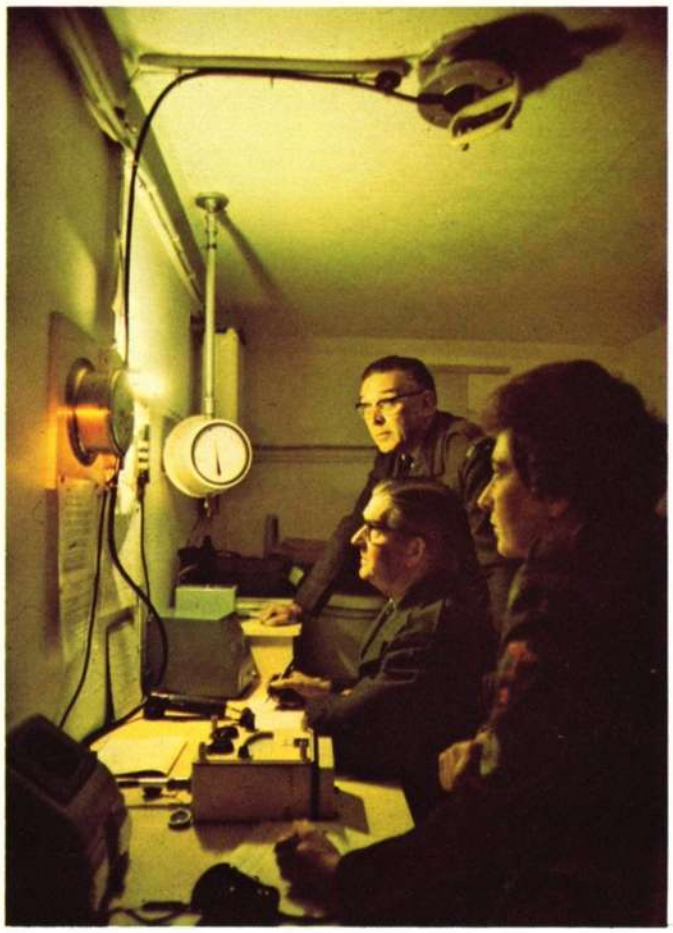
While the "Rats" were being dealt with, the Corps itself was undergoing a major reorganisation. A new Commandant, Air Commodore Ambler, took over in 1942. Unlike his predecessors, he was a serving RAF officer and ever since then the Corps has had a regular Air Commodore at the helm. Ambler changed the whole shape of the ROC. RAF battledress was introduced, together with Officer and NCO ranks. Groups no longer had a Controller and an OGO, but command was vested in an overall Group Commandant with the rank of Observer Commander. The older men at Centres were told they had to go, which caused great resentment, and their places were taken by women. The first women had joined the Corps in 1941, and women's libbers may be surprised to learn that from the outset both sexes had the same ranks and the same opportunities.

Ambler, at the instigation of the Air Ministry, also closed down the Royal Observer Corps Club and its production of aircraft recognition material, which had included the highly successful Corps journal. Henceforth, all material was issued from official sources and training was done on a Corps basis with an instructor for each Post. It had been embarrassing, to say the least, to have a crowd of amateurs showing the Air Ministry the way!

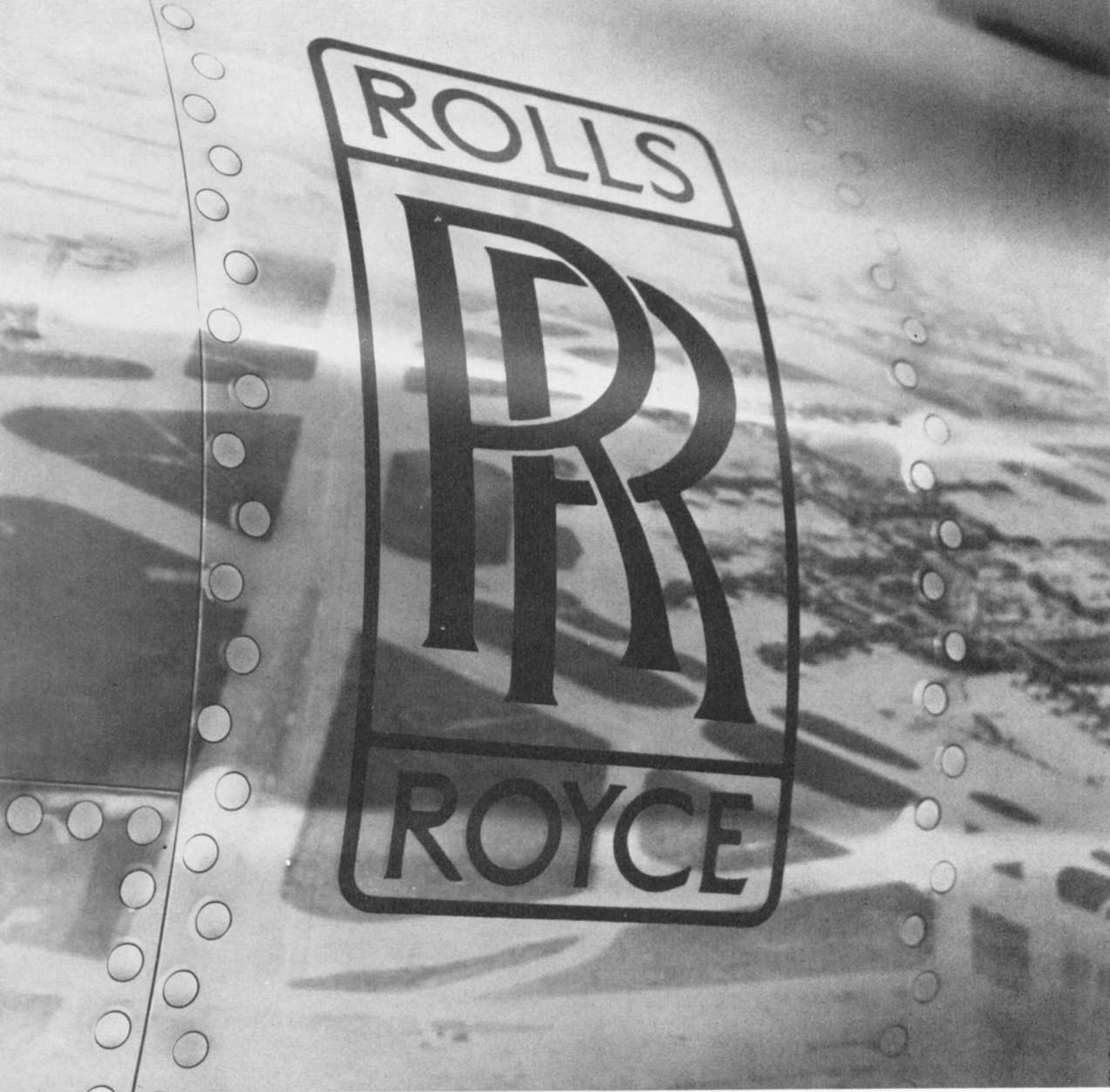
With the vast number of allied aircraft operating daily from Britain – the unsinkable aircraft carrier – the ROC became more and more concerned with getting "lame ducks" back to base. Based on the use of ROC Posts and Centres, a new safety organisation was set up in the RAF. A number of Posts were equipped with "Darky" HF radio sets while others were provided with homing searchlights. Finally, many Posts near high ground were equipped with "Granite" warning flares. Thousands of wartime aircrew owed their lives directly to action taken by the ROC using this equipment.

Radar was supposed to be the rival that would put the Corps out of business, but in 1942 the ROC went into the radar business on its own account. Selected Posts in eastern England were equipped with Army Gun Laying (GL) radars, which they used at night to sort out whether aircraft were showing IFF (Interception Friend or Foe) signals. The *Luftwaffe* had begun to infiltrate the returning streams of RAF bombers and it was necessary to pick out the jokers in the pack.

By 1943, new Centres had been provided for ROC Groups, with not only the main map table, but also a "Long Range Board" on which tracks in adjoining Groups could be displayed. The air raid



Above: The Monitoring Room of an underground Post with the crew watching the instruments. The white dial suspended from the pipe in the ceiling is the Bomb Power Indicator which measures the peak overpressure of a nuclear explosion. Below: the triangulation team at an ROC Centre work out the position and power of nuclear bursts.



London Heathrow Airport (British Airports Authority photograph).

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warning system was moved across to the ROC and the Air Raid Warning Officers ordered the sirens to be sounded direct from their seats on the dais at ROC Centres. These alterations were completed in time for the "Little Blitz" which began in January 1944. This proved to be the last major effort against Britain by the *Luftwaffe* using manned aircraft.

The next assault from the air was unpiloted, in the shape of the pulse-jet-powered V-1 flying bomb. The first of these roared across the Kent coast on the night of 13 June 1944. It was correctly identified and plotted, not by radar, but by the ROC in the form of two middle-aged Observers on a Martello Tower at Dymchurch. Throughout the V-1 campaign, the Corps in the south and east was at full stretch both by day and by night. RAF officers were put into two ROC Centres and controlled the fighters direct from the map table, while the Posts fired signal rockets to illuminate the path of the robots, which were code-named "Diver". Later in 1944, another German reprisal weapon, the V-2 rocket, appeared, but there was nothing the air defences, including the ROC, could do about it. The Corps, however, plotted the rocket trails as they soared up from Holland and on at least one occasion they were visible to Posts as far north as Manchester.

Into Europe

Before the V-1s appeared, the ROC had been entrusted with a further vital task, that of spotting for the D-Day invasion fleet. The C-in-C Allied Air Force, Air Chief Marshal Sir Trafford Leigh-Mallory, was extremely concerned lest, with the poor standards of aircraft recognition prevailing, large numbers of friendly aircraft should be shot down by the fleet and enemy aircraft get through unscathed.

To overcome the deficiency, ROC Groups were asked to provide volunteers to serve aboard ship during the landings, the scheme being known as "Seaborne". Some 796 observers were trained at Bournemouth, kitted out, and given the rank of Aircraft Identifier (equivalent to a Petty Officer). They served in pairs aboard armed merchant ships for up to two months off the Normandy beachhead. At first the ships' Captains were suspicious of these curious men in RAF uniform with "Seaborne" flashes on their shoulders. The attitude of the mariners changed abruptly when they discovered that the ROC personnel could indeed identify anything they could see. In many ships, Observers literally controlled the guns and numerous allied airmen's lives were saved thereby. Two observers were killed during the invasion and 10 were mentioned in despatches.

After they returned to the Corps, all those who served afloat were allowed to retain their "Seaborne" flashes and there are still today Officers and Observers serving in the Corps who wear them.

For the ROC it was certainly a case of "first in, last out" and although Europe's V-Day came on 8 May 1945, the Corps was not stood down until 12 May – just in case any fanatics should take it into their heads to have a last bombing fling.

With the coming of peace, the whole ROC network was closed down, with only a small band of officers maintaining the Corps, Area and Group headquarters. It was not reactivated until January

In action in 1940; 17sK.1 Post on top of the London University Building in Gower Street. The Observer on the right is sighting the instrument on a distant aircraft, while his colleague on the left reports position, direction and height of the aircraft to the Centre at Watford.

ROC Centres in wartime. Below: No 17 Group Watford as it appeared in 1940 with the Post Plotters round the map table and the Tellers behind. Above: the balcony of the No 19 Group, Bromley, Centre in 1943, with the Tellers looking down on the map table below.

1947, when a nucleus of the wartime volunteers began to instil life once more into the Posts and Centres. The Soviet threat from 1948 onwards accelerated efforts to complete the rebuilding of the ROC, which had lost a great many of its purpose-built Posts and some of its Centres. The Corps occupied a vital position as the overland reporting network while the RAF's radar chain was being rebuilt and modernised. This was emphasised by the decision of the AOC-in-C Fighter Command, Sir Basil Embrey, in 1950 to bring the ROC under the full control of the Command with the status of an RAF Group.

On weekend exercises the Corps plotted and tracked, the targets becoming faster as jets replaced the older piston-engined types of aircraft. Each year thousands of Observers travelled to the ROC Summer camps which were, and still are, staged annually at an RAF airfield. King George VI became Air Commodore in Chief Royal Observer Corps in April 1950, and, on the occasion of her Coronation in June 1953, Her Majesty the Queen Elizabeth II assumed the same appointment.

In 1953, the Corps had its Area and Group boundaries completely reorganised to bring them into line with the then new RAF Sector boundaries based on the "Rotor" radar plan. It was not long, however, before the speed and altitude of aircraft like the Canberra and the Valiant began to make visual and aural tracking

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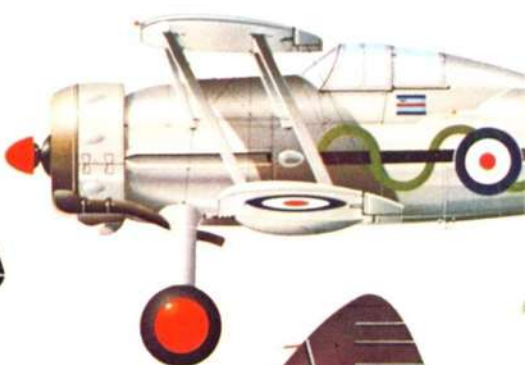
(Above) Sopwith F.1 Camel: Having first seen action with the RFC in 1917, the Camel equipped 30-plus RAF squadrons, that illustrated (F6314) serving with No 65 Sqdn

(Above) Sopwith 7F.1 Snipe: Introduced as a successor to the Camel, the Snipe reached the Western Front in September 1918 and was finally withdrawn from the RAF in 1927. The example illustrated (E1832) flew with No 208 Sqdn in 1918

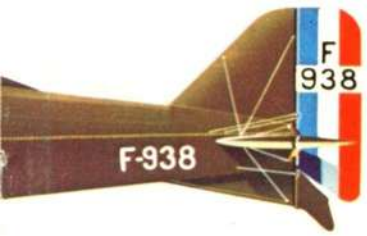
(Left) Bristol Bulldog IIA: Chosen successor to the Siskins and Gamecocks, the Bulldog entered service in June 1929 and the Mk IIA from late 1930, remaining in first-line use until 1937. Illustrated is K2159 of No 17 Sqdn

(Immediately below) Gloster Gauntlet II: Last RAF open-cockpit fighter, the Gauntlet served 1935–39. Illustrated is K5272 of No 111 Sqdn

(Immediately below) Boulton Paul Defiant II: A failure as a day fighter, as which it entered service in December 1939, the Defiant served in the nocturnal role 1940–41. The Mk II illustrated belonged to No 125 Sqdn

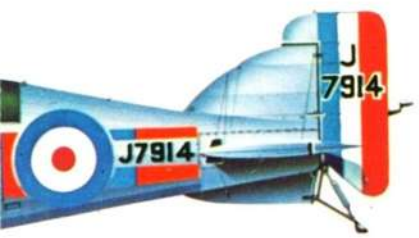


(Right) Bristol Blenheim IF: A three-seat day and night fighter, the Blenheim IF served from December 1938 until mid-1941. The Blenheim IF illustrated (L1437) operated in 1940 with No 25(F) Sqdn



(Above left) RAF S.E.5a: One of the outstanding WW I fighters, the S.E.5 entered RFC service in March 1917, and the S.E.5a three months later, equipping 16 squadrons. A Wolseley Motors-built S.E.5a is illustrated

(Above) Bristol F.2B: One of the mainstays of the RAF in its formative years, the F.2B served until 1932, that shown being operated by No 139 Sqdn in 1918. (Below) Armstrong Whitworth Siskin IIIA: Serving from 1927 to 1932, the Siskin IIIA illustrated belonged to No 43 Sqdn



(Above left) Gloster Gamecock: The last fighter biplane of wooden construction to serve with the RAF, the Gamecock entered service in March 1926, that illustrated (J7914) having been operated by No 23 Squadron

(Below) Hawker Demon: The Demon entered service (experimentally) with the RAF in March 1931, reviving the two-seat fighter class. The turret-less example illustrated was operated by No 604 Sqdn in 1936

(Above left) Hawker Fury I: The most elegant of RAF fighter biplanes, the Fury I entered service in the summer of 1931 and retired from first-line service in 1939, that illustrated (K2048) belonging to No 1 Sqdn

(Below) Hawker Hurricane I: One of the most famous of RAF fighters, the Hurricane I entered service at the end of 1937 with No 111 Sqdn

(Above left) Gloster Gladiator I: Noteworthy as the last of the RAF's fighter biplanes, the Gladiator entered service in February 1937, and the last examples of this fighter were withdrawn from operational use in 1942. Gladiator I (K8042) of No 87 Sqdn is illustrated

(Below) Supermarine Spitfire IA: Perhaps the most famous fighter of all time seen here in Mk IA version with No 72 Sqdn (1939)

(Above) Westland Whirlwind: The first twin-engined single-seat fighter to see RAF service, the Whirlwind illustrated served with No 263 Sqdn (1941)

NOT TO SCALE

RAF ——— ***continued from page 12***

importance and output of the 16 University Air Squadrons throughout the UK, which are operated by full-time RAF personnel and provide spare time flying training totalling about 70 hours during the three-year course for students at 46 universities and other degree-awarding establishments in the UK. After this pre-entry training on Scottish Aviation Bulldogs from the 132 ordered by the RAF, graduates enter the RAF College, Cranwell, which now functions as a general service training establishment, as well as operating Jet Provosts for basic training, and also administers the University Air Squadrons.

The remaining 50 per cent or so of the pilot recruit intake, comprising direct entrants, first undertake 15 hrs of aptitude flying with the Primary Flying Grading Squadron at No 2 FTS, Leeming, on the Bulldog. No 2 FTS, which also provides primary training for RN helicopter students on a 75-hr fixed-wing course on the Bulldog, is the only regular RAF unit to operate this aircraft, apart from the Central Flying School.

From the Bulldog, student pilots move on to the basic phase of flying training at No 1 FTS Linton-on-Ouse, or at Cranwell to complete 100 hrs on the Jet Provost T Mk 3A, in the case of direct entry cadets, or 75 hrs on the Jet Provost T Mk 5A for UAS graduates. For these rôles, 179 RAF Jet Provosts are being up-dated by the installation of improved avionics, including VOR, ILS and DME. In the same stage, students will receive 25 hrs in a Jet Provost simulator, and will qualify for the award of their pilot's brevet. Up to the end of 1974, newly qualified pilots were then "streamed" into three main groups. Fast jet students now undergo a further 60 hrs on the Jet Provost 5A in Advanced Stage I, followed by 70 hrs on the Gnat at No 4 FTS, Valley (which has most of the 52 in the current RAF inventory), and 50 hrs on the 20 Hunter T Mk 7s and FGA 9s at the Tactical Weapons Unit at Brawdy, before continuing to an OCU. Multi-engined pilot candidates were scheduled to complete 80 hrs of flying in the Scottish Aviation Jetstream turboprop twin, which began replacing the Varsity in the latter part of 1974, but with the massive transport pilot redundancies following the defence review, this stream has been temporarily suspended. This suspension is expected to last for at least 18 months and the 26 Jetstreams still being delivered by Scottish Aviation are being stored pending a decision on their future employment. Consideration is being given to handing over future multi-engine pilot training (MEPT) to the College of Air Training, Hamble, at a later date, following trial refresher courses at this civil establishment which the RAF has recently initiated.

Hawker Siddeley Hawk T Mk I Cutaway Drawing Key

1 UHF/VHF aerial
2 Di-electric fin tip
3 Fin structure (upper)
4 Honeycomb rudder
5 Compass detector
6 Rudder actuator
7 Rudder trim tab
8 Rudder trim tab
9 Machined lower-half fin spars
10 Fin/fuselage attachment bolts
11 Tailplane power control unit
12 Tailplane centre-section
13 Rear jet-pipe support
14 Deflector plate
15 Tail cone
16 Rear navigation light
17 Jet-pipe exhaust
18 All-moving tailplane
19 Fin-spar pick-up frame
20 Tail bumper
21 IFF/SSR aerial

22 Airbrake jack
23 Airbrake (extended)
24 Ventral anti-collision beacon
25 Jet-pipe
26 Rear fuselage frames/stringers
27 Engine/jet-pipe separation frame
28 Hydraulic reservoir contents gauge (port and starboard)
29 Hydraulic reservoir
30 Tailfin fairing
31 Ram air turbine (stowed)
32 Access panels
33 Engine accessories
34 Rolls-Royce Turboméca RT.172-06 Adour turbofan
35 Engine forward support mounting

36 Fuel vent tank
37 Gas turbine starter
38 Starter air intake (port and starboard)
39 Ram air exhausts
40 Dorsal anti-collision beacon
41 Ram air intake scoops
42 Heat exchangers
43 Skin doubler plates
44 Flying controls
45 Fuselage top diaphragm
46 Fuselage bag tank
47 Intake cowl structure
48 Intake trunking
49 Intake forward frames
50 Oxygen cylinders
51 Rear pressure bulkhead

52 Intake
53 Boundary-layer bleed
54 Battery
55 Forward fuselage structure
56 Instructor's ejection seat
57 Spray pipe
58 Instrument console
59 Headrest
60 Canopy detonating cord
61 Port aileron
62 Localiser aerial
63 Port navigation light
64 Wing skinning
65 Side-hinged one-piece canopy

66 Instructor's windscreen
67 Gunsight
68 Canopy hinge line
69 Headrest
70 Instrument console
71 Sloping canopy
72 Canopy frame
73 Gunsight
74 Control column
75 Instrument panel shroud
76 Curved one-piece windscreen
77 Front pressure bulkhead
78 IFF/SSR aerial
79 Nosewheel compartment
80 Pitot head
81 Landing lamp
82 Nosewheel doors
83 Nosewheel leg
84 Towing lug
85 Nosewheel
86 Shock absorber

87 Rear nosewheel flap
88 Forward equipment bay
89 Rudder pedals
90 TACAN aerial
91 Underfloor controls
92 ILS aerial
93 Pupil's ejection seat

94 Main electrics panel
95 External fuse panel
96 External power-socket
97 Frangible nose-cap
98 30-mm Aden gun (in external pod)
99 Main undercarriage door
100 Ventral gun pod
101 Wing-fuselage attachment points
102 Lower longeron
103 Wing integral fuel tank
104 Undercarriage leg pivot point
105 Retraction jack
106 Towing lug
107 Mainwheel leg
108 Starboard mainwheel
109 Auxiliary tank
110 Stores pylon
111 Side leg doors
112 Front spar
113 Access panels

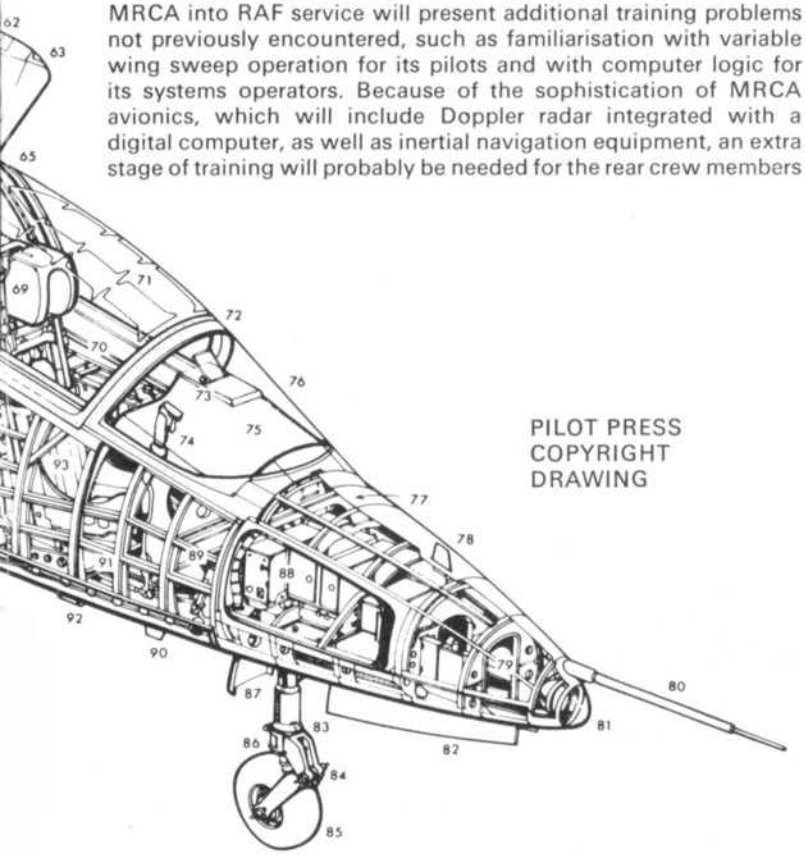
114 Hinged access doors
115 Gun pod link collector box
116 Starboard flap
117 Flap actuator
118 Rear spar
119 Aileron control linkage
120 Starboard aileron
121 Wing ribs
122 Starboard navigation light
123 Glideslope aerial

The strategic element of the RAF's transport force is now concentrated upon the BAC VC10 (left) and the Short Belfast (right), the Britannia and Comet fleets having been axed in the recent defence cuts. Scottish Aviation Bulldog T Mk 1s (below) equip the University Air Squadrons and No 2 FTS

In the third stream, rotary-wing students now complete all their helicopter flying, totalling 90 hrs, on 16 Whirlwind HAR 10s at Tern Hill, following the phasing-out last year of the RAF's last piston-engined Sioux, before moving on to an OCU. At one time, the RAF planned to use about a dozen Westland WG 13 Lynx HT Mk 3s for advanced helicopter training, but procurement plans had to be abandoned because of funding problems and because it was decided that all-through Gazelle training was a practical and sensible programme. A similar number of Westland-Aérospatiale Gazelle HT Mk 3s are used for training helicopter instructors by the RAF, which may eventually replace its training Whirlwinds with Gazelles on a long-term basis. Following completion of the advanced training stage, successful graduates then leave Training Command for operational conversion in their designated combat rôles, although some 20 per cent of helicopter pilots go straight to squadrons.

Additional changes in pilot training will result from the planned introduction of the Hawker Siddeley Hawk for the advanced phase at Valley towards the end of 1976, when it will begin replacing both the Gnat and the Hunter. The 175 production Hawks currently on order for the RAF will allow a reduction of at least 10 hrs in the advanced course by eliminating the need for conversion to the Hunter. The Hawk is scheduled to take over the weapon training rôle now performed by the Hunter and may allow this to be achieved at an earlier stage in the curriculum.

Looking further ahead, to 1977–78, the introduction of the MRCA into RAF service will present additional training problems not previously encountered, such as familiarisation with variable wing sweep operation for its pilots and with computer logic for its systems operators. Because of the sophistication of MRCA avionics, which will include Doppler radar integrated with a digital computer, as well as inertial navigation equipment, an extra stage of training will probably be needed for the rear crew members



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DRAWING

of the MRCA before joining up at the OCU. As a tripartite project, however, the MRCA programme is likely to extend to multi-national crew training, which is considered essential from the cost viewpoint. The RAF is examining the possibility of establishing a joint OCU for the MRCA, probably in the UK in view of our far greater background of rear crew member experience, but there are problems of language and finance to be overcome.

The training of all RAF aircrew other than pilots is now concentrated at No 6 FTS Finningley, which runs courses for navigators, air electronics officers and air engineers. Because of the high costs of flying training, particularly in the advanced stages (about 80 per cent of the £500,000 cost of training a Jaguar pilot occurs in the OCU), the RAF is making increasing use of flight simulators and other sophisticated training aids such as the EMI-developed Radar Video Tape Recorder (RVTR) system. The latter equipment records radar signals in the air which can then be reproduced in flight simulators, and has so far produced extremely promising results.

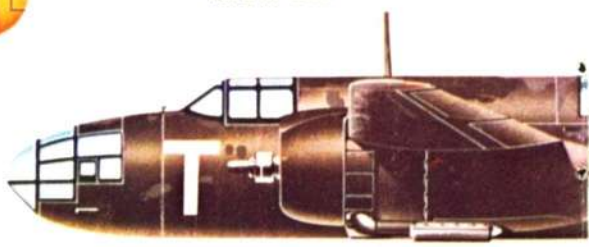
Exploration is still being carried out concerning the degree to which simulators may replace costly flying training, but No 6 FTS already comprises the largest simulator complex in the RAF, and in the case of navigator training, for example, it is planned to reduce the present 160-hr flying course to about 120 hrs by the more extensive use of ground training aids. Now that the venerable Varsity has finally been phased out, navigator trainees will fly a total of 90 hrs on the Jet Provost (for low-level exercises) and HS 125 Dominie (for radio navigation), followed by a further 30 hrs advanced flying on the same aircraft. They then move on to a fast jet or multi-engine OCU. Navigators for the Phantom and Buccaneer force of Strike Command have also been undergoing low-level training in the four remaining Handley Page Hastings in RAF service, in a flight of No 230 OCU at Scampton.

Air Electronics Officers undergo a 48-hr, 48-week course on the Dominie, plus no less than 204 hrs of simulator time, while the air engineer's course also involves 25 hrs in the Dominie over a period of 46 weeks. Nimrod rear crew members also complete 140 hrs of simulator time. As a result of the defence review and the increasing use of simulators, the planned conversion of 14 Argosy transports as rear crew trainers being undertaken by Hawker Siddeley at Bitteswell has been abandoned, and these aircraft are expected to be scrapped.

The views and statements contained in the foregoing article are those of the author alone and are neither endorsed nor confirmed as being those of the Ministry of Defence.

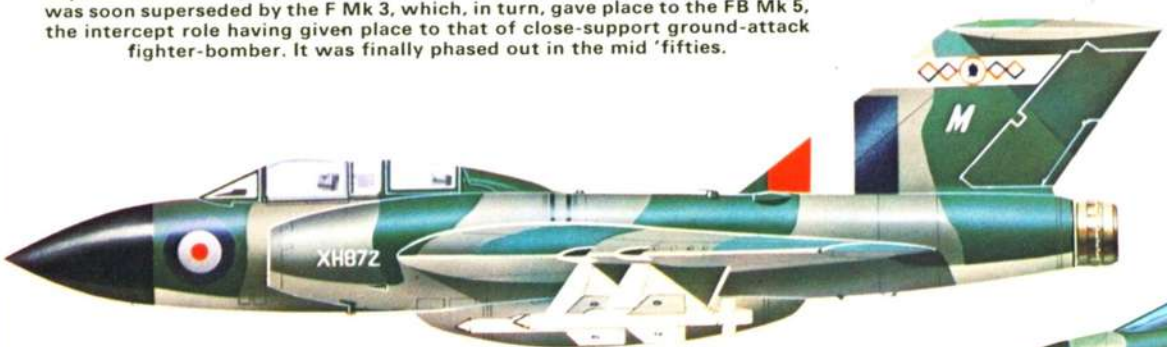
(Above) Curtiss Tomahawk IIB: Entering service in mid-1941 with the RAF, the Tomahawk served in the low-level tactical recce role at home but served as a fighter with the Desert Air Force, a No 112 Sqdn aircraft (AN413) being illustrated.

(Below) Douglas Havoc I: A night fighting and nocturnal intruder version of the Boston, the Havoc I illustrated (BD112) served with No 23 Sqdn at Ford in 1941.



(Above) North American Mustang IV: One of the outstanding fighters of WW II, the Merlin-engined Mustang entered RAF service in February 1944, the Mk IV illustrated (KM118) belonging to No 19 Sqdn. (Right) Bristol Beaufighter TF X: One of the most ubiquitous of the RAF's WW II aircraft, the Beaufighter is seen in TF Mk 10 form (NE237) as flown by No 455 Sqdn.

(Above) De Havilland Vampire F 1: The second jet fighter type to enter RAF service, the Vampire F 1 joined No 247 Squadron in the summer of 1946, an unpressurised example (TG301) flown by that unit being illustrated. The F Mk 1 was soon superseded by the F Mk 3, which, in turn, gave place to the FB Mk 5, the intercept role having given place to that of close-support ground-attack fighter-bomber. It was finally phased out in the mid 'fifties.



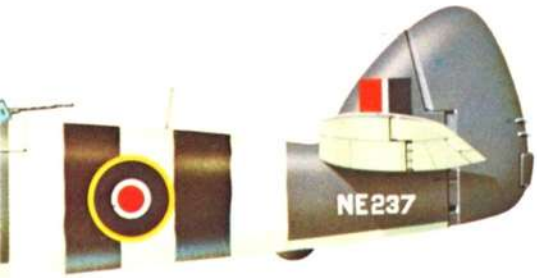
(Above) Gloster Javelin FAW 9: The last of a long line of RAF Gloster fighters, the Javelin was first issued to No 46 Sqdn in February 1956. The last model, the FAW Mk 9, an example of which (XH872) is illustrated as operated by No 64 Sqdn, being phased out early 1968. (Below) Hawker Siddeley Harrier GR 1: The world's first V/STOL strike and reconnaissance fighter to achieve service, the Harrier equips four RAF squadrons, that illustrated (XV783) belonging to No 4 Sqdn, Wildenrath (1970).

(Above) McDonnell Douglas Phantom FGR 2: Now being transferred to the air defence role in RAF service, the Phantom FGR 2 originally fulfilled ground attack and recce fighter tasks, that illustrated (XT901) belonging to No 17 Sqdn.

(Right) SEPECAT Jaguar GR 1: The Jaguar Anglo-French tactical strike and reconnaissance fighter will eventually account for the largest single element in the RAF's frontline strength, equipping eight squadrons. The Jaguar GR 1 illustrated (XX726) is flown by No 6 Squadron, the RAF's second operational Jaguar unit.

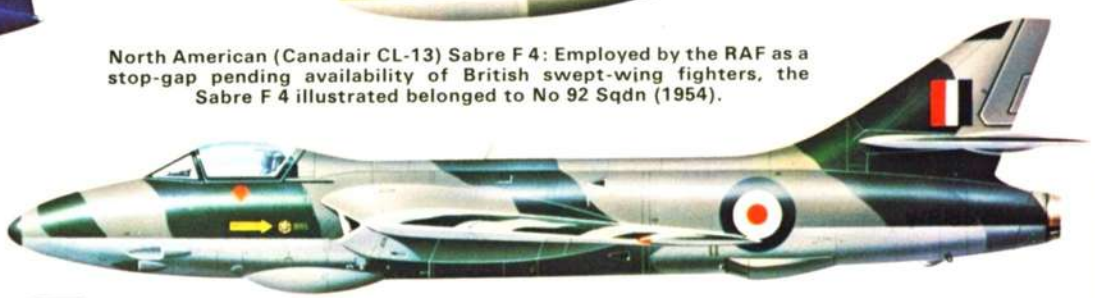
(Above) Hawker Typhoon IB: An outstanding close-support fighter, the Typhoon IB joined combat in 1942, that illustrated (JR371) belonging to No 198 Sqdn.

(Above) Hawker Tempest II: Intended for operations with Tiger Force in the Far East, the Tempest II entered service in November 1945 and the last were finally superseded in 1951. The Tempest II illustrated (PR797) was operated in Germany in 1947 by No 33 Squadron.

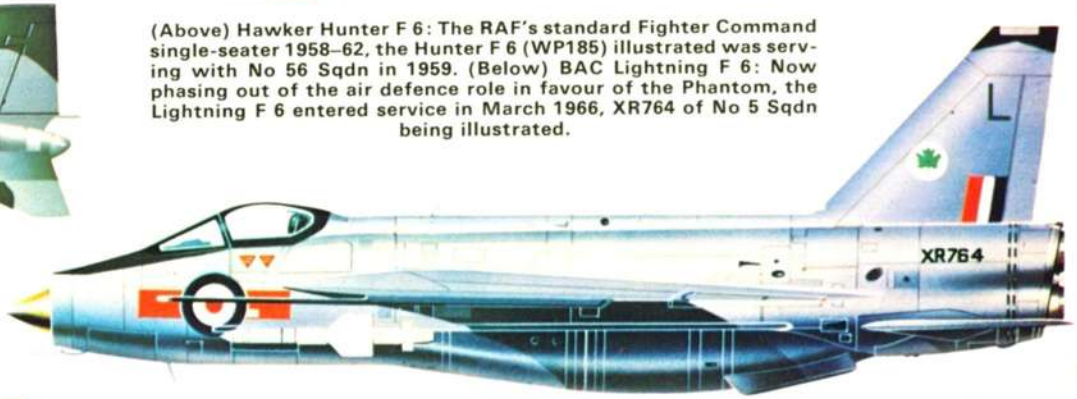


North American (Canadair CL-13) Sabre F 4: Employed by the RAF as a stop-gap pending availability of British swept-wing fighters, the Sabre F 4 illustrated belonged to No 92 Sqdn (1954).

(Above) Gloster Meteor F 8: The major type of single-seat day interceptor with the RAF during 1950–55, the Meteor F 8 illustrated was operated by No 500 Sqdn at West Malling (1953).



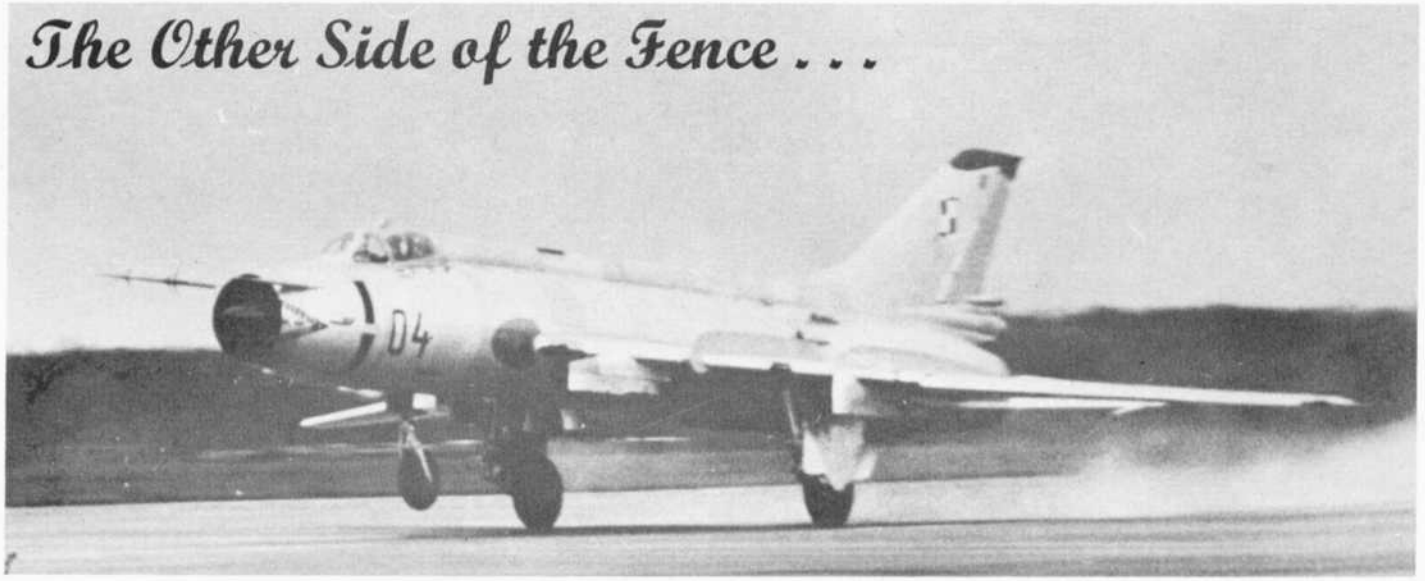
(Above) Hawker Hunter F 6: The RAF's standard Fighter Command single-seater 1958–62, the Hunter F 6 (WP185) illustrated was serving with No 56 Sqdn in 1959. (Below) BAC Lightning F 6: Now phasing out of the air defence role in favour of the Phantom, the Lightning F 6 entered service in March 1966, XR764 of No 5 Sqdn being illustrated.



(Below) Panavia MRCA: A two-seat multi-purpose fighter scheduled to join Strike Command 1977–78 to replace Vulcans, Canberras and Buccaneers, the MRCA is also scheduled to fulfil the intercept role in the RAF as a successor to the Phantom.

NOT TO SCALE

The Other Side of the Fence . . .



THE WARSAW PACT AIR FORCES

UNPALATABLE THOUGH IT MAY BE, it is an incontestable fact that, at this time, when all West European air forces are contending with funding problems arising from swingeing budgetary restrictions on defence expenditure, the aerial threat to NATO posed by the Warsaw Pact forces has never been greater. This heightened threat, viewed with serious concern in western military circles, stems from recent progressive upgrading, in both qualitative and quantitative terms, of the inventories of the Warsaw Pact air forces facing NATO in Central Europe – the most vulnerable territory on the continent, since it lacks buffer zones – compounded by a significant change in Soviet military tactics from a basically defensive to a highly mobile offensive posture.

Quantitatively, the Warsaw Pact air forces have for long enjoyed a very substantial edge in aircraft over their NATO counterparts facing them in Central Europe. Of late, this superiority has begun to encroach also on the qualitative advantage hitherto possessed by NATO; enhanced capability evidenced in recent Warsaw Pact exercises in close air support manœuvres and by the accelerating tempo of the phase-in of formidable and more versatile new combat aeroplanes – such as the Su-19 *(Fencer-A)*, the MiG-23 *(Flogger)*, the MiG-25 *(Foxbat)* and the Mi-24 *(Hind-A)* – which are being accompanied by significant advanced in radar technology and the use of electronics to guide and command weapon systems.

Embracing the Soviet Union, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland and Rumania, the Warsaw Treaty Organisation, which this year saw the 20th anniversary of its ratification, provides for a Joint High Command consisting of the Commander-in-Chief, the Chief-of-Staff and a Military Council comprising permanent military representatives of each of the signatories to the Treaty, this Command being responsible to the Council of Defence Ministers and the primary channel through which orders are transmitted to the various national forces in peacetime. The posts of C-inC and C-of-S of the Joint High Command are always held by Soviet officers, as are most of the key positions, and in the event of hostilities, the Command automatically becomes operationally subordinate to the Soviet High Command. The Treaty Organisation also has a Military Staff which includes senior non-Soviet officers

Soviet Air Defence Capability

The backbone and much of the rib-cage of Warsaw Pact air power in Central Europe is, of course, provided by the Air Forces of the USSR, or *Voenno-vozdushniye Sily* (V-VS), which, commanded by Chief Marshal of Aviation Pavel Stepanovich Kutahov, deploy strong elements in Czechoslovakia, Poland, Hungary and East Germany – upwards of 800 V-VS aircraft are based on East German airfields alone – and the P-VO *Strany* Headquarters in Moscow exercises overall control of the entire Warsaw Pact air defence and warning system.

The P-VO *Strany (Protivo-vozdushnaya Oborona [Strany]*, or Air Force of the Anti-aircraft Defence of the Homeland) has been a separate command of the Armed Forces of the USSR for the past 27 years. Responsible for the air defence of the main centres of industry and population, and comprising anti-aircraft artillery, surface-to-air missiles (SAMs), ground-based and airborne control and early warning radar, and a very substantial interceptor force, it is by far the most extensive and expensive air defence system in the world, operating over 4,000 radars located at early warning and ground control intercept sites and about 12,000 SAM launchers. The manned interceptor element, known as the *Istrebitel'naya Aviatsiya P-VO Strany*, or IAP-VO *Strany*, currently possesses upwards of 2,600 first-line combat aircraft, its largest unit for organisational purposes being the Division *(Divisiya)* which comprises three and sometimes more regiments *(polki)*, each of which usually possesses three squadrons *(eskadrilii)* of 12 aircraft. All squadrons in each regiment operate the same aircraft type and the inventory of each squadron usually includes two or three dual-rôle (ie, equipped to fulfil both training and operational functions) aircraft.

While the numerical strength of the IAP-VO *Strany* has been declining at an annual rate of some 100 aircraft over the past decade, the overall capability of the force has grown steadily during this period with the phasing in of new and more sophisticated intercepter fighters, in the re-equipment with which the IAP-VO traditionally enjoys priority. Effectiveness has been significantly enhanced over the past 18 months by the phase-in of a markedly improved version of the Su-15 *(Flagon-E)* and increasing numbers of the versions of the MiG-23 *(Flogger)* and MiG-25 *(Foxbat)* optimised for the intercept rôle. The Su-15 single-seat delta-winged all-weather interceptor has served with the IAP-VO *Strany* for six–seven years in its *Flagon-A* and *-C* variants (the latter being a dual-rôle two-seater), and is numerically the most important interceptor deployed in the two P-VO Districts, the more recent *Flagon-E* having more powerful engines, improved avionics, more advanced weapons and an overall improvement in its performance envelope by comparison with preceding models. The MiG-23, a variable-geometry fighter armed with cannon and four AAMs – which also possesses impressive close air support and interdiction capability in its *Flogger-B* version – is now appearing in the intercept rôle in significant numbers, as is also the MiG-25 *(Foxbat-A)*, a Mach 3·0 aircraft intended for operation at high altitudes and not stressed for high manœuvrability at lower altitudes.

Over the next few years it is anticipated that these aircraft will have largely supplanted older all-weather intercept equipment in

the ranks of the IAP-VO, such as the Su-11 *(Fishpot-C)* and the Yak-28P *(Firebar)*, while the ageing Tu-28P *(Fiddler)*, employed primarily to mount standing patrols over areas not screened by surface-to-air missiles around the Soviet periphery, is now being phased out in favour of a long-range heavy interceptor derivative of the Tu-22 *(Blinder)* bomber. Limited airborne controlled intercept capability is provided by the Tupolev *Moss* airborne warning and control system (AWACS) aircraft, but the USSR has yet to demonstrate a radar able to detect and track from high altitude a bomber at low altitude against a background of clutter, this placing a fundamental constraint on the effectiveness of the IAP-VO.

The P-VO *Strany* deploys its forces in two P-VO Districts, the *Moskovsky Okrug P-VO* (Moscow) and the *Bakinsky Okrug P-VO* (Baku), and elsewhere in the USSR air defence is the responsibility of the P-VO units assigned to the various Military Districts which tie in with the P-VO *Strany* but which come under the direct control of the local Military District Air Command Headquarters. The IAP-VO formations assigned to these Military Districts form, in effect, integral parts of the respective District or Forces Group aviation components. The principal Military Districts are Moscow, Leningrad, Baltic, Kiev, Volga, Trans-Caucasian, North Caucasian, Carpathian, Ural, Odessa, Byelo-Russia, Central Asia, Turkistan, Trans-Baikal, Siberian and Far East. The Forces Groups comprise the Northern Group of Forces with Headquarters at Legnica, Poland, the Southern Group of Forces with Headquarters at Tokol, Hungary, the Central Group of Forces with Headquarters at Milovice, Czechoslovakia, and the Group of Soviet Forces in Germany with Headquarters at Zossen-Wünsdorf. In addition, there are a number of Frontier Troop Districts (eg, Eastern Frontier District) to which IAP-VO formations are assigned.

Each District includes IAP-VO regiments according to its importance, this also affecting re-equipment priority, and the major qualitative upgrading of the manned interceptor elements has, apart from the two P-VO Districts, taken place of late in the area opposite NATO and particularly with units deployed with the Group of Soviet Forces in Germany. Obsolescing types, such as the MiG-17 *(Fresco)* and MiG-19 *(Farmer)*, have been entirely displaced by late models of the MiG-21, such as the MiG-21SMT *(Fishbed-K)* affording increased endurance and equipped with updated avionics and AAMs, and the MiG-23 *(Flogger)*, and many early-model MiG-21s (eg, *Fishbed-C*) have been phased out.

Despite the size of the Soviet air defence force and the improvements that are being introduced, however, major weaknesses exist in low-altitude defences against penetrating bombers and in defence against the USAF's short-range attack missile (SRAM), and it would seem probable that high priority is being assigned by the USSR to the development of a more effective AWACS aircraft than *Moss*, better airborne radar to improve IAP-VO interceptor fighter capability at low altitudes and improved radar for GCI (Ground Controlled Interception).

Tactical Attack Capability

The primary tactical element of the V-VS and also the largest operational component, the *Frontovaya Aviatsiya* (FA), or Frontal Aviation, currently possesses marginally more than 5,000 first-line combat aircraft (plus about 3,000 tactical-type aircraft employed in training rôles) which it deploys within the various military and frontier districts, according to their importance, and with the Forces Groups based in other Warsaw Pact countries. The largest formation is the *divisiya* and elements attached to a specific Military District or Forces Group are referred to by the designation of the District or Group (eg, *Aviatsiya Severnoi Gruppi Voisk*, or Aviation of the Northern Group of Forces). Each *divisiya* is normally equipped with aircraft performing one rôle (eg, close support, tactical strike, etc.).

During the past two years, the FA – and particularly those elements facing NATO in Central Europe – has enjoyed a major infusion of new tactical aircraft which has dictated some re-evaluation of western projections of V-VS tactical capability over the remainder of the present decade. Perhaps the most significant of the new tactical aircraft being phased in by the FA at the present time – and already deployed by the Aviation of the Group of Soviet Forces in Germany which appears to receive priority among the Forces Groups in re-equipment – is the Su-19 *(Fencer-A)* variable-geometry tactical strike fighter broadly comparable with the General Dynamics F-111 and allegedly possessing the range with which to attack any NATO airfield in West Europe – admittedly more vulnerable than their Soviet counterparts – from East German bases. East German-based FA units have also been the first outside the Soviet Union to re-equip with the Su-17 *(Fitter-C)* variable-geometry ground attack fighter successor to the fixed-wing Su-7 *(Fitter-A)* and the Mi-24 *(Hind)* gunship and assault transport helicopter. Retaining much of the structure of the Su-7 and embodying relatively minor increases in power and fuel capacity, the Su-17 nevertheless represents a marked improvement over its precursor, offering better shortfield performance, a larger warload and greater versatility. The Mi-24 helicopter is serving with the FA in two versions – the *Hind-A* which has formidable ground attack capability with a total of six weapons stations on two auxiliary wings for UV-32-57 pods each containing 32 55-mm S-5 rockets and AT-3 *Sagger* wire-guided

(Head of opposite page). An Su-17 variable-geometry ground attack fighter of the Polish Air Forces. (Above) A MiG 23B variable-geometry multi-rôle fighter of an FA unit of the Aviation of the Group of Soviet Forces in Germany, and (right) MiG-21MF interceptors of an IAP-VO regiment assigned to the Carpathian Military District

(Above) A Phantom FG 1 of No 43 Squadron based at Leuchars formating on a Tu-20 (Bear-D) engaged in a probe mission. The intruder had been spotted by RAF radar at Buchan, Scotland. The Bear-D can be employed for the anti-shipping missle control rôle, the PPI display showing target location and missile launching site, the aircraft thus serving as an intermediate control station, ensuring precise terminal guidance. (Below, left) An Su-17 (Fitter-C) ground attack fighter of the Polish Air Forces

anti-tank missiles, and the *Hind-B* which has reduced weapons capacity and accommodates up to 16 assault troops.

Other newer types that have now appeared in significant numbers are the MiG-23B *(Flogger-B)* variable-geometry multi-rôle fighter and the MiG-25R *(Foxbat-B)* high-altitude reconnaissance aircraft, both of which are also being deployed in East Germany. A substantial proportion of the FA first-line aircraft inventory is made up of the Yak-28 *(Brewer)* serving in tactical strike, reconnaissance and ECM (Electronic Countermeasures) escort rôles, the last-mentioned version *(Brewer-E)* having been phased in from 1970 as the FA's first operational ECM escort aircraft; various versions of the MiG-21 *(Fishbed)*, the most recent version of which to see widespread service, the MiG-21SMT *(Fishbed-K)*, having upgraded avionics and augmented internal fuel capacity provided by means of a "saddle" tank which boosts maximum endurance to 3·5 hours; the Su-7BMK *(Fitter-A)* ground attack fighter the principal shortcomings of which are a strictly limited warload and poor short-field performance, and the Mi-8 *(Hip)* helicopter, which, while primarily intended for the transport rôle, is extensively employed as a gunship, normal armament consisting of four UV-32-57 rocket pods carried on racks strut-rigged on the fuselage sides, although some examples have been reported as being fitted with up to 16 racks for rocket pods, eight each side of the fuselage in two rows of four, one above the other. One of the most dramatic changes to be seen in the FA elements deployed along the western periphery of the USSR has, of late, been the quantitative and qualitative increase in the helicopter force, a substantial proportion of which is provided by the Mi-8. It is estimated that a total of some 2,000 helicopters is now available to to the FA.

The phase-out of obsolescing aircraft has accelerated over the past two years, the Yak-27R *(Mangrove)* having been retired and most of the remaining MiG-17 *(Fresco)* and MiG-19 *(Farmer)*

WARSAW PACT AIR FORCES INSIGNIA

(Above) An Mi-24 (Hind-A) gunship and assault transport helicopter operating with the Aviation of the Group of Soviet Forces in Germany. UV-32-57 rocket pods may be seen on the two inboard weapons stations of each auxiliary wing. The double-carrier on each vertical extension at the tips of the auxiliary wings can accommodate AT-3 Sagger wire-guided anti-tank missiles. (Below, right) The Ka-25 (Hormone-A) is the standard anti-submarine warfare helicopter of the naval aviation component, the AV-MF

fighters, together with early model MiG-21 *(Fishbed)* fighters, have been relegated to Military or Frontier Districts of minor importance and can be expected to disappear completely from the V-VS inventory over the next three–four years. FA deployments between Groups of Forces or Military Districts change to some extent with variations in world tensions. For example, Sino-USSR relations have resulted in some 18–20 FA Divisions with 2,000–2,200 aircraft being on permanent assignment to the Military Districts bordering on Chinese territory, between Tadzhikistan (Central Asian MD) and the Pacific, but any sudden increase in tension could allegedly result in this force being increased by 50 per cent within a week. Individual FA units are, on occasions, deployed outside the Soviet Union and the Warsaw Pact countries (eg, early in 1975, a MiG-25R-equipped unit was performing reconnaissance missions from a base in Egypt), and this component of the V-VS also apparently has a commitment for intelligence gathering over countries on the Soviet periphery (eg, over-flights of Iranian territory by MiG-25Rs).

Strategic Capability and Naval Air Power

The strategic bombing component of the V-VS, the *Aviatsiya Dal'nevo Deistviya* (ADD), or Long-range Aviation, has progressively diminished in importance with the growth of the Strategic Rocket Forces *(Raketny Voiska Strategicheskovo Naznacheniya)*, and now possesses barely more than 100 ageing Tu-20 *(Bear)* and M-4 *(Bison)* long-range heavy bombers compared with a peak strength of 700–800 in the late 'fifties and early 'sixties. The majority of the M-4s have been adapted for the flight-refuelling tanker rôle and as withdrawn from the ADD, a proportion of the Tu-20s have been adapted for use by the AV-MF (Naval Air Force) for long-range maritime and "ferret" rôles with optical and non-optical sensors, and for anti-shipping missile control tasks. The ADD has maintained a rather larger force of medium-range bombers, however, and this is currently spearheaded by upwards of 300 Tu-22 *(Blinder)* aircraft with a numerically similar but steadily declining force of obsolescent Tu-16 *(Badger)* aircraft.

The capability of the ADD is now being upgraded, however, by the introduction of a variable-geometry supersonic bomber assigned the reporting name *Backfire* and ascribed to the Tupolev design bureau. Only some 20 examples of *Backfire* had reportedly been deployed by mid-1975, approximately half of these at an ADD base in South-West Russia and the other half at an AV-MF base in the Black Sea region. In its *Backfire-B* version, this new strategic bomber – the primary attack armament of which consists of a 460-mile (740-km) range stand-off missile – is believed to be capable of covering virtually the entire USA on a two-way subsonic mission with limited low-level penetration if employing in-flight refuelling and staged from Arctic bases. Staging from the Chukotsk Peninsula, the unrefuelled radius of *Backfire* should enable it to cover the western USA in an arc generally extending from the western US-Mexican border to the eastern tip of Lake Superior. Tanker support is required for *Backfire* for intercontinental missions involving supersonic dash or extended low-altitude operation, and the aircraft is apparently compatible with the M-4 *(Bison)* tanker, although it is likely that a tanker variant of the Il-76 *(Candid)* is under development. Although the intercontinental capabilities of *Backfire* are significant, it is nevertheless the consensus of western opinion that the aircraft is intended primarily for peripheral missions, against European NATO members or China.

The Naval Air Force, or *Aviatsiya Voenno-morskovo Flota* (AV-MF), has assumed steadily increasing importance in recent years and will undergo a major expansion of seagoing capability when the first of two *Kiev*-class aircraft carriers joins the Soviet Navy next year, her sistership probably joining her during 1978–79. Intended primarily for the direct support of the four Soviet Fleets – Baltic, Northern, Black Sea and Pacific – the AV-MF is still

(Above, top to bottom) A MiG-21F clear-weather interceptor of the Rumanian air arm; a Sukhoi Su-17 ground attack fighter of the Polish air arm and a MiG-23B fighter-bomber of the Soviet Frontal Aviation

primarily a shore-based force, the only AV-MF units so far deployed aboard naval vessels being equipped with Ka-25 *(Hormone)* ASW helicopters and operating from two *Moskva* class half-deck "anti-submarine cruisers" and from platforms aboard *Kresta*- and *Kara*-class cruisers.

Possessing a similar organisation to the other Air Forces of the V-VS and, despite its naval affiliation, employing military ranks, the AV-MF forms a substantial shore-based force with the primary rôles of long-range maritime surveillance and ELINT (ELectronic INTelligence) for which the Tu-16 (in its *Badger-D, -E* and *-F* versions), the M-4 (in its *Bison-B* and *-C* versions) and the Il-38 *(May)* are utilised, medium-range ASW reconnaissance being performed by the Be-12 *(Mail)* amphibious flying boat. The anti-shipping strike task is fulfilled by some 250–300 Tu-16s (in its AS-5 *Kelt*-equipped *Badger-G* version) supplemented by some 50 Tu-22 *(Blinder-C)* bombers, the latter apparently limited to free-fall weapons or short-range missiles as distinct from the long-range anti-ship missiles of the Tu-16. This anti-shipping strike force, which currently provides the primary AV-MF threat to NATO naval forces, is seemingly now being augmented by *Backfire-B* which will substantially expand the anti-shipping rôle of the AV-MF in both range and capability.

(Below) An Mi-2 (Hoplite) helicopter of the Polish Air Forces fitted with pylons for rockets or gun pods, or wire-guided anti-tank missiles, on outriggers attached to the fuselage sides

For the short-range ASW task, the Ka-25 *(Hormone)* is now used almost exclusively, with the Mi-8 *(Hip)* fulfilling the mine-sweeping rôle and providing assault transport for the *Morskaya Pekhota* – literally naval infantry and somewhat similar to the British Marines. The two *Moskva*-class anti-submarine cruisers each accommodate up to 20 Ka-25 helicopters, these vessels having a full load displacement of 18,000 tons, and the two *Kiev*-class carriers are expected to each have a complement of up to 35 Ka-25 helicopters and V/STOL fighters when they join the Fleet. The V/STOL fighter, for which no designation or reporting name is available at the time of going to press, was flown in prototype form in 1970, and the first AV-MF unit was reportedly working up on this type mid-1975 preparatory to deployment aboard the *Kiev* next year. The *Kiev* and her sistership, reportedly to be named *Minsk*, will each displace some 31,250 tons.

The total inventory of the AV-MF at the present time is believed to number some 1,200 aircraft of all types, something over half of these being considered first-line fixed-wing aircraft or rotorcraft.

The Satellite Air Forces

After the Soviet Union, Poland possesses the largest air arm among the members of the Warsaw Pact. Commanded by General of Division Henryk Michalowski, the Polish Air Forces, or *Polskie Wojska Lotnicze* (PWL), form what is essentially a tactical force with an organisation based broadly on that of the V-VS. Possessing strong defensive capabilities, the PWL has an inventory of 800–900 aircraft of all types. Its largest formation is

the *Dywizjon* (Division), usually abbreviated as *Dyon*, which is sub-divided into *Pulki* (Regiments), a *Dyon* generally comprising three *pulki* which are each roughly comparable with a RAF wing, the smallest component being the *Eskadra* (Squadron), three or more *eskadry* forming a *Pulk*.

With the phase-out of the last MiG-19 *(Farmer)* equipped *eskadry*, the entire PWL interceptor force of some 10 *pulki* operates the MiG-21 *(Fishbed)* in various versions (including the MiG-21PFM, PFMA and MF) and, together with the anti-aircraft artillery and the surface-to-air missile batteries, comes under the Command of the Air Defence Forces of National Airspace *(Dowodztwo Wojsk Obrony Przeciwlotniczej Obszaru Kraju)* and is tied in to the P-VO *Strany* Headquarters in Moscow. The secondary task of the interceptor force is the provision of air cover for the so-called Operational Air Force *(Lotnictwa Operacyjnego)* formed by the tactical fighter-bomber and ground attack components which come under the direct control of the Command of the Air Forces *(Dowodzstwo Wojsk Lotniczych)* and are known as the Fighter-Bomber Aviation *(Lotnictwo Mysliwsko-bombowe)* and the Ground Attack Fighter Aviation *(Lotnictwo Mysliwsko-szturmowe)*. This tactical force is predominantly equipped with the Su-7 *(Fitter-A)* and consists of five–six *pulki* of which at least one is still operating the LIM-6, a modified version of the Polish-built MiG-17F *(Fresco-C)* for the ground attack rôle, and another began conversion to the Su-17 *(Fitter-C)* last year. A proportion of the 150-strong PWL helicopter force is provided by a gunship version of the Polish-built Mi-2 *(Hoplite)* with four AT-3 *Sagger* wire-guided anti-tank missiles, rocket or gun pods on racks strut-rigged from each side of the fuselage.

Poland also possesses a small shore-based naval air arm (the *Lotnictwo Marynarki Wojennej*, or Naval Aviation Force) which, apart from the equivalent of one *pulk* operating the LIM-6 in the anti-shipping rôle, operates Mi-2 and Mi-8 *(Hip)* helicopters for coastal patrol, ASW and minesweeping tasks.

(Above) Numerically the most important helicopter in the inventory of the V-VS, the Mi-8 (Hip) is seen in this photograph fitted with rocket pods strut-rigged from each side of the fuselage

The Czechoslovak Air Force, or *Ceskoslovenské vojenské letectvo*, is, like that of Poland, a tactical air force with strong defensive capabilities. Controlled by the Air Force Command *(Velitelstvi letectva)*, which is an integral part of the Anti-aircraft Defence of the State *(Protivzdusná obrana státu)*, the *letectvo* is only some two-thirds the size of Poland's air arm. The basic formation is the Air Regiment *(Letecky pluk)* which normally comprises three *letky* (a *letka* approximating to an RAF squadron), five–six Fighter Regiments *(Stihacich pluku)* fulfilling the intercept rôle with various sub-types of the MiG-21 *(Fishbed)*, including the MiG-21PF, PFMA and MF *(Fishbed-E* and *-J)*, and forming

(Below, top to bottom) A MiG-21MF limited all-weather interceptor of the Czechoslovak air arm; a LIM-6 (modified MiG-17F) ground attack fighter of the Polish air arm and a MiG-21MF of the East German air arm

an integral part of the Warsaw Pact defence system with Headquarters in Moscow. There are four tactical Fighter-bomber Regiments *(Stíhací bombardovací pluky)* equipped with the Su-7B and Su-7BMK *(Fitter-A)*, and a number of tactical reconnaissance *letky* operating the MiG-21R and RF *(Fishbed-H)*. Re-equipment of at least one *letka* with the Su-17 *(Fitter-C)* is expected to commence during the course of this year, and the introduction of the MiG-23 by the *letectvo* is also anticipated.

The Czechoslovak air arm has an inventory of some 700 aircraft of all types, including approximately 25 per cent helicopters, manned by some 42,000 personnel, compared with a personnel strength of about 56,000 for Poland's air arm (excluding the naval aviation element), whereas the third-ranking "satellite air arm", that of the German Democratic Republic, has a personnel strength of the order of 30,000. Bearing the ponderous appellation of National People's Army Air Force and Air Defence *(Nationale Volksarmee Luftstreitkräfte und Luftverteidigung)* but usually abbreviated as LSK/LV, the East German air arm comes under the overall command of the Ministry of National Defence *(Ministerium für Nationale Verteidigung)* as an integral component of the *Nationale Volksarmee*, and collaborates closely with the large and, of late, appreciably modernised V-VS component to which East Germany acts as host, the Aviation of the Group of Soviet Forces in Germany.

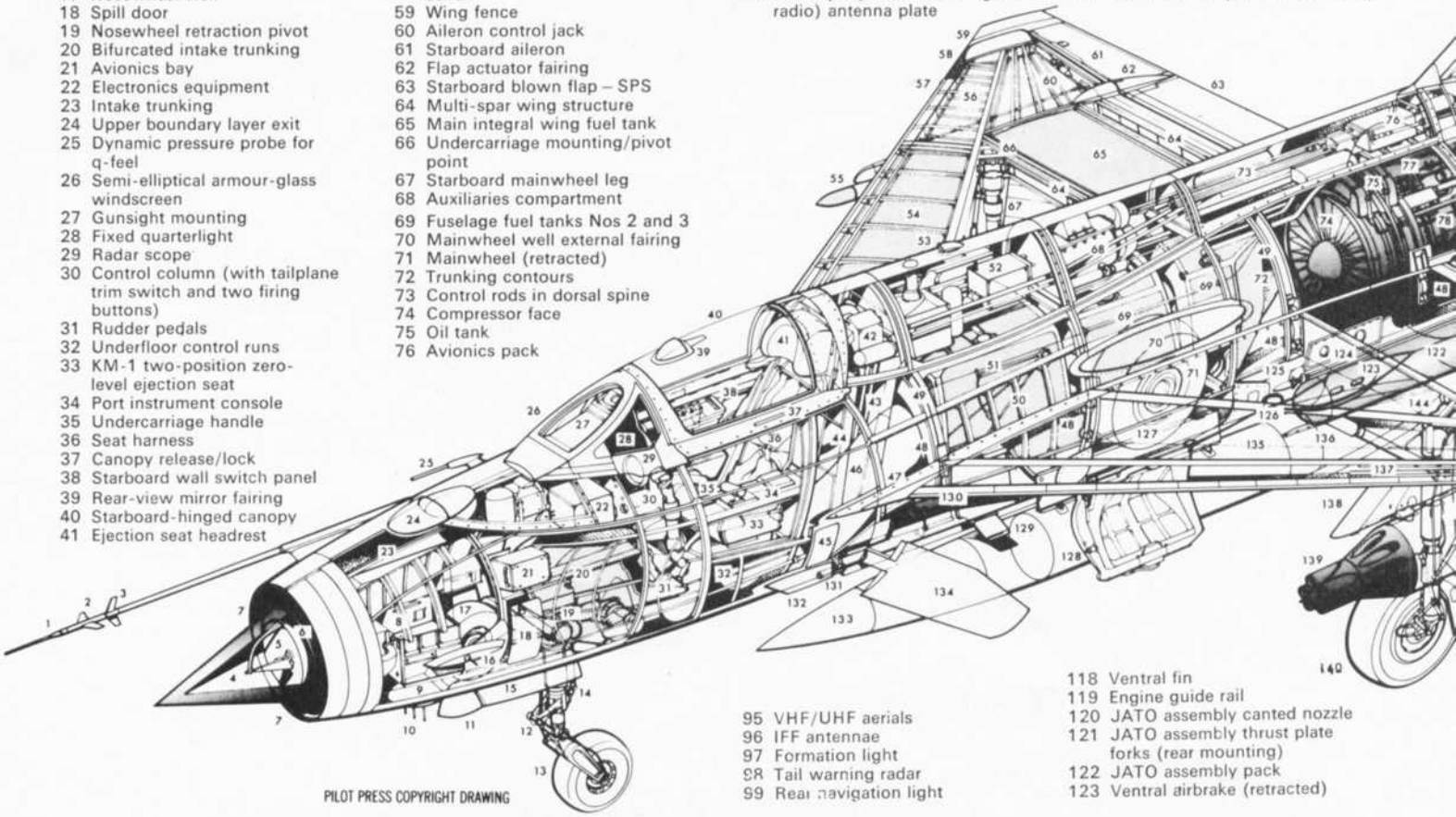
Possibly as a result of the strong strike and close support capability of the V-VS contingent deployed in East Germany, the operational element of the LSK/LV is orientated almost entirely towards air defence, its principal manned aircraft components being two Fighter Divisions – Nr 1 *Jagddivision* with Headquarters at Cottbus and Nr 3 *Jagddivision* with Headquarters at Neubrandenburg – each comprising three-four *Jagdgeschwader* (approximating to an RAF wing) with a statutory strength of 48 MiG-21 *(Fishbed)* limited all-weather interceptors. There is a strong helicopter force possessing support and assault tasks and equipped with the Mi-2 *(Hoplite)*, Mi-4 *(Hound)* and Mi-8 *(Hip)*, a proportion of the 100 or so helicopters in the LSK/LV inventory being fitted with gun or rocket pods, or wire-guided anti-tank missiles.

Of the remaining three Warsaw Pact air forces, that of Hungary, the *Magyar Légierö*, is by far the smallest, with barely more than 100 combat aircraft and a personnel strength numbering some 12,000. Its largest formation is the Air Division *(Repülö Hadosztály)* which nominally comprises three Regiments *(Ezred)* each of three squadrons *(szérad)*, but this organisation would seem somewhat academic as the *Légierö* currently possesses an operational component consisting of only two MiG-21-equipped Regiments for the intercept rôle and one Regiment fulfilling the ground attack task with the Su-7 *(Fitter)*.

The Bulgarian air arm *(Balgarski vozdusny vojski*, or Bulgarian People's Air Force) has a personnel strength of some 20,000 officers and men, and approximately 200–220 combat aircraft but a higher proportion of obsolescing equipment than other Warsaw

MiG-21MF Cutaway Drawing Key

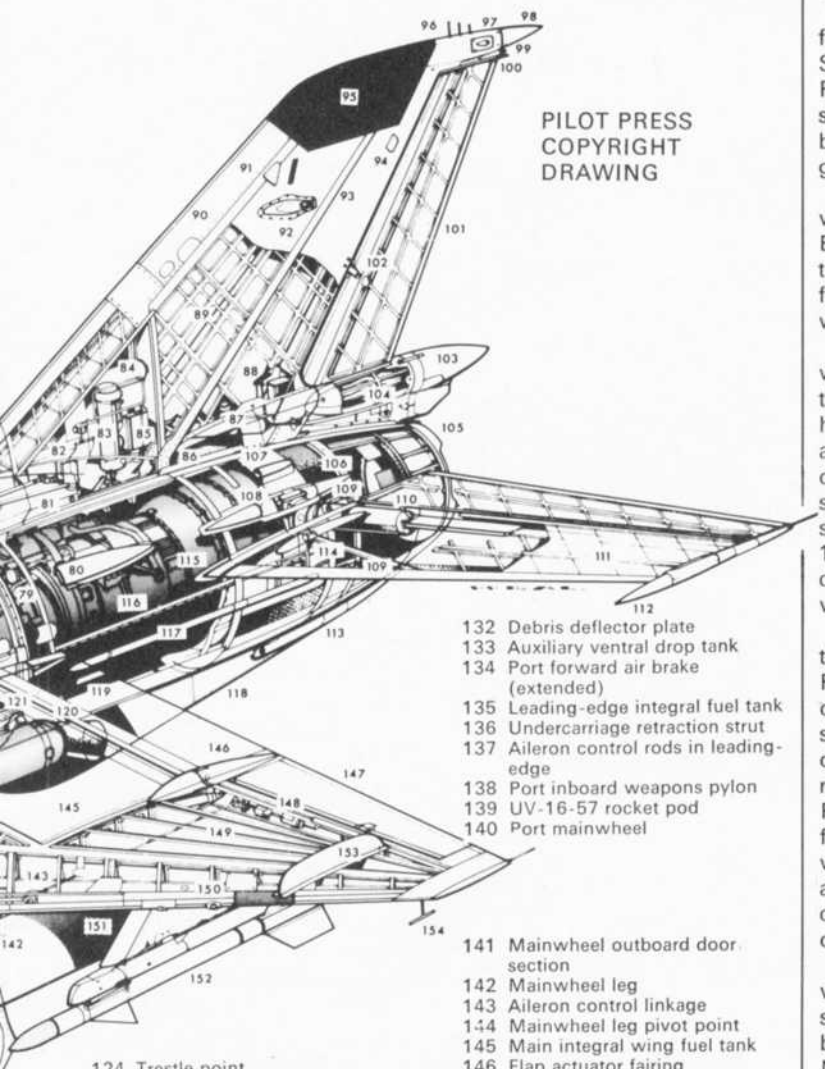
1 Pitot-static boom
2 Pitch vanes
3 Yaw vanes
4 Conical three-position intake centrebody
5 "Spin Scan" search-and-track radar antenna
6 Boundary layer slot
7 Engine air intake
8 Radar ("Spin Scan")
9 Lower boundary layer exit
10 Antennae
11 Nosewheel doors
12 Nosewheel leg and shock absorbers
13 Castoring nosewheel
14 Anti-shimmy damper
15 Avionics bay access
16 Attitude sensor
17 Nosewheel well
18 Spill door
19 Nosewheel retraction pivot
20 Bifurcated intake trunking
21 Avionics bay
22 Electronics equipment
23 Intake trunking
24 Upper boundary layer exit
25 Dynamic pressure probe for q-feel
26 Semi-elliptical armour-glass windscreen
27 Gunsight mounting
28 Fixed quarterlight
29 Radar scope
30 Control column (with tailplane trim switch and two firing buttons)
31 Rudder pedals
32 Underfloor control runs
33 KM-1 two-position zero-level ejection seat
34 Port instrument console
35 Undercarriage handle
36 Seat harness
37 Canopy release/lock
38 Starboard wall switch panel
39 Rear-view mirror fairing
40 Starboard-hinged canopy
41 Ejection seat headrest
42 Avionics bay
43 Control rods
44 Air conditioning plant
45 Suction relief door
46 Intake trunking
47 Wingroot attachment fairing
48 Wing/fuselage spar-lug attachment points (four)
49 Fuselage ring frames
50 Intermediary frames
51 Main fuselage fuel tank
52 RSIU radio bay
53 Auxiliary intake
54 Leading-edge integral fuel tank
55 Starboard outer weapons pylon
56 Outboard wing construction
57 Starboard navigation light
58 Leading-edge suppressed aerial
59 Wing fence
60 Aileron control jack
61 Starboard aileron
62 Flap actuator fairing
63 Starboard blown flap – SPS
64 Multi-spar wing structure
65 Main integral wing fuel tank
66 Undercarriage mounting/pivot point
67 Starboard mainwheel leg
68 Auxiliaries compartment
69 Fuselage fuel tanks Nos 2 and 3
70 Mainwheel well external fairing
71 Mainwheel (retracted)
72 Trunking contours
73 Control rods in dorsal spine
74 Compressor face
75 Oil tank
76 Avionics pack
77 Engine accessories
78 Tumansky R-13 turbojet (rated at 14,550 lb/6 600 kg with full reheat)
79 Fuselage break/transport joint
80 Intake
81 Tail surface control linkage
82 Artificial feel unit
83 Tailplane jack
84 Hydraulic accumulator
85 Tailplane trim motor
86 Tailfin spar attachment plate
87 Rudder jack
88 Rudder control linkage
89 Tailfin structure
90 Leading-edge panel
91 Radio cable access
92 Magnetic detector
93 Tailfin mainspar
94 RSIU (very-short-wave fighter radio) antenna plate
95 VHF/UHF aerials
96 IFF antennae
97 Formation light
98 Tail warning radar
99 Rear navigation light
100 Fuel vent
101 Rudder construction
102 Rudder hinge
103 Braking parachute hinged bullet fairing
104 Braking parachute stowage
105 Tailpipe (variable convergent nozzle)
106 Afterburner installation
107 Afterburner bay cooling intake
108 Tailplane linkage fairing
109 Nozzle actuating cylinders
110 Tailplane torque tube
111 All-moving tailplane
112 Anti-flutter weight
113 Intake
114 Afterburner mounting
115 Fixed tailplane root fairing
116 Longitudinal lap joint
117 External duct (nozzle hydraulics)
118 Ventral fin
119 Engine guide rail
120 JATO assembly canted nozzle
121 JATO assembly thrust plate forks (rear mounting)
122 JATO assembly pack
123 Ventral airbrake (retracted)



PILOT PRESS COPYRIGHT DRAWING

Pact air forces, retaining the MiG-17F *(Fresco-C)* and MiG-19S *(Farmer-C)* in its first-line inventory. The basic formation is the Regiment (*Polk*) and there are reportedly three regiments operating the aged MiG-17F, two of these fulfilling the ground attack rôle and one the intercept rôle, and each comprising three 12–16 aircraft squadrons *(eskadrilas)*. One four-squadron Regiment performs the intercept task with the MiG-21F and PF, and another Regiment was reportedly in process of converting from the MiG-19S to the MiG-21MF mid-1975. There is a small naval aviation element *(Morsko vozdusny vojski)* but this is now equipped exclusively with helicopters.

Rumania's contribution to the air strength of the Warsaw Pact, somewhat grandiloquently entitled Air Forces of the Rumanian Socialist Republic *(Fortele Aeriene ale Republicii Socialiste România)* and administered by the Armed Forces Ministry *(Ministerul Fortelor Armate)*, comprises some 160 first-line combat aircraft. The *Fortele Aeriene* is equal in status with the Armour and Infantry components of the Rumanian armed forces and is primarily an interceptor force. The largest formation is the Air Division *(divizie aeriana)* which is sub-divided into Air Corps *(corpuri aeriene)*, each of which consists of two or more Aviation Regiments *(regimente de aviatie)*. Five regiments fulfil the intercept rôle, these being equipped primarily with the MiG-21 although two of the regiments reportedly still include a number of MiG-17s in their inventories. There are also two ground attack fighter regiments equipped principally with the Su-7 *(Fitter-A)*. Total personnel strength is of the order of 22,000 officers and men.



124 Trestle point
125 JATO assembly release solenoid (front mounting)
126 Underwing landing light
127 Ventral stores pylon
128 Mainwheel inboard door
129 Splayed link chute
130 Twin 23-mm GSh-23 cannon installation
131 Cannon muzzle fairing
132 Debris deflector plate
133 Auxiliary ventral drop tank
134 Port forward air brake (extended)
135 Leading-edge integral fuel tank
136 Undercarriage retraction strut
137 Aileron control rods in leading-edge
138 Port inboard weapons pylon
139 UV-16-57 rocket pod
140 Port mainwheel
141 Mainwheel outboard door section
142 Mainwheel leg
143 Aileron control linkage
144 Mainwheel leg pivot point
145 Main integral wing fuel tank
146 Flap actuator fairing
147 Port aileron
148 Aileron control jack
149 Outboard wing construction
150 Port navigation light
151 Port outboard weapons pylon
152 "Advanced Atoll" infra-red guided AAM
153 Wing fence
154 Radio altimeter antenna

ROC* ——— *continued from page 35

more difficult. In addition, the RAF changed its whole radar programme and embarked on a new layout based on a few high power "Master" radars. Aircraft reporting continued, using such communications as were available, until 1960 when the RAF restricted it to a low-level belt in the eastern half of England covering the approaches to the V-bomber bases which operated the nuclear deterrent.

Meanwhile, from 1955 onwards, the Corps had become the chosen field force for reporting the burst of nuclear weapons and subsequent fall-out. The Home Office provided the funds for the building of 31 self-contained protected operations rooms and 1,563 underground Posts. As the aircraft reporting rôle diminished, so the nuclear task became more important. The Home Office United Kingdom Warning and Monitoring Organisation paid first 80 per cent and, later, 90 per cent, of the Corps' costs and took over operational control.

In 1965 the eastern low-level visual reporting belt disappeared and the principal tasks of the ROC became solely nuclear, with aircraft recognition maintained as a skill should the RAF require to use it, but with little opportunity to demonstrate efficiency beyond local and national contests between posts and between the Corps and other organisations.

The links with the RAF were not broken, however, as the ROC had formed Nuclear Reporting Cells to operate in the Air Defence Operations Centre and other RAF headquarters, and these still exist today. Commanders in all three Services must have the latest information on nuclear weapon strikes and the arrival of radio active fall-out if they are to function at all.

Originally, the scientists who are expected to make the complex forecasts on fall-out movement were housed at RAF Fighter Sectors but as these were vacated by the Service under the Master Radar scheme, it became apparent that custom built Home Office sector rooms would be needed. Accordingly, five of these were built as extensions to existing ROC Group headquarters, thus greatly lessening the risk of damage to communications.

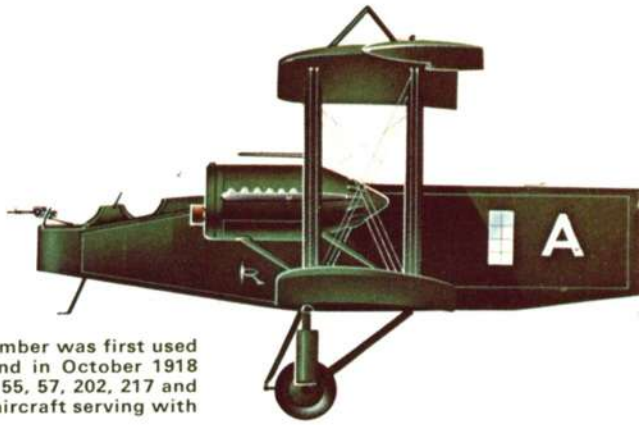
On 24 June 1966, Her Majesty the Queen presented the ROC with a banner during the course of a Royal Review staged at Bentley Priory to mark the 25th Anniversary of the granting of the title "Royal" to the Corps. A total of 756 Officers and Observers from all Groups in the country attended the Review and the banner was dedicated by the Chaplain-in-Chief Royal Air Force.

When the Civil Defence Corps and the Auxiliary Fire Service were swept away in the defence cuts of 1968, it seemed possible that the ROC's long history would also be brought to an abrupt halt. The skills of the Corps were, however, considered to be vital and it was retained, albeit with a sharp cut in strength and the loss of 686 Posts and two Groups. Posts were limited to a personnel strength of only 10 members each. Resilient as ever, the Corps sorted itself out, re-grouped yet again and pressed on into the 1970s. Now 10,000 strong, it reaches its 50th Anniversary as a close-knit volunteer force, still wearing RAF-type battledress but with traditions and customs all its own.

Every Post in the country could be operational in a very short time in the event of an emergency. With instruments installed, the Posts can report the explosion of a nuclear weapon and its peak overpressure, measure its size, elevation and bearing and subsequently report the fall-out that it yields. Where landlines break down, reports can be relayed by radio. Similarly, the Operations rooms can be rapidly manned and the crews would process the Post information while having their own first warning of the bomb from an electronic device called Awdrey. Many of the Posts are warning points which would sound the attack alarm with sirens and the fall-out warning with maroons. Both Posts and Centres are capable of operating for a week without the crews having to come out in the open.

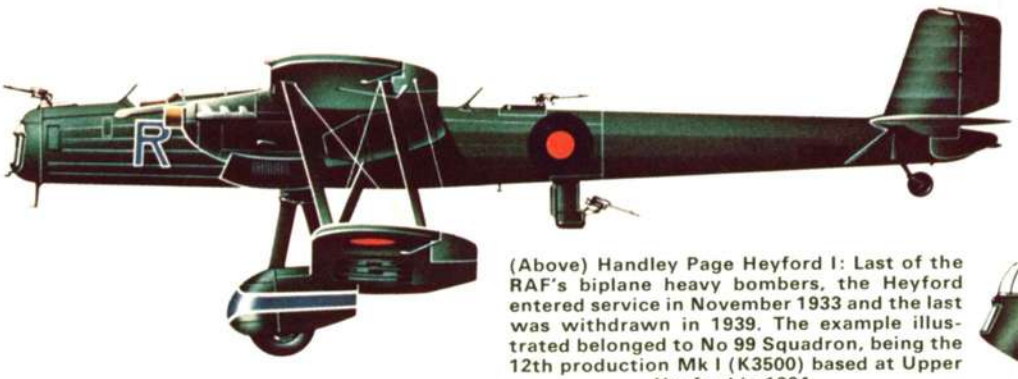
Even if a heavy attack with Megaton and Kiloton nuclear weapons was made on Britain, literally millions of lives could be saved if the public was warned in time to take shelter, first from the blast and later from fall-out. The motto of the UK Warning and Monitoring Organisation is "Sound an Alarm" – it provides a suitable complement to the Royal Observer Corps' motto, "Forewarned is Forearmed".

This article is based on material contained in a history of the Corps entitled "Attack Warning Red", by Derek Wood, which is to be published by Macdonald and Janes.

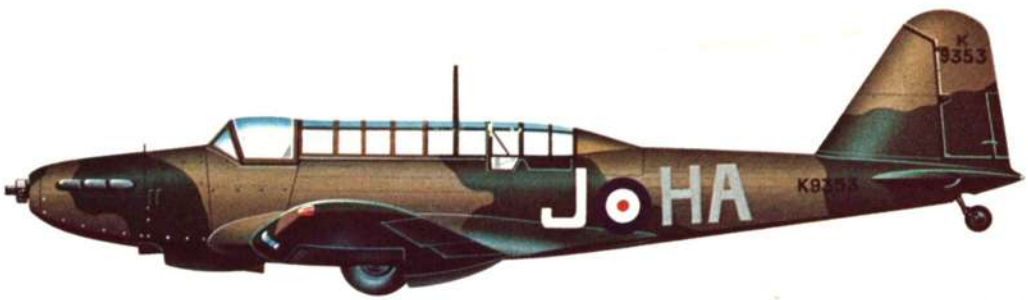


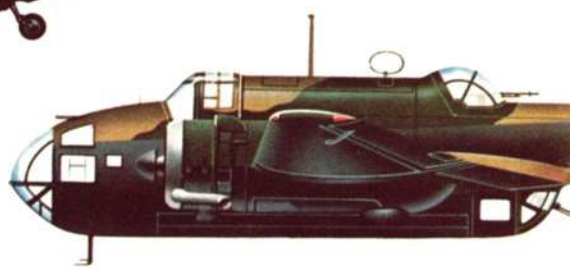
(Above left) De Havilland D.H.4: The D.H.4 two-seat day bomber was first used operationally on 6 April 1917 by No 55 Squadron, RFC, and in October 1918 remained in service with seven RAF squadrons (Nos 18, 25, 55, 57, 202, 217 and 244). The example illustrated (N5967) was a Westland-built aircraft serving with No 205 Sqdn.

(Above) De Havilland D.H.9A: One of the most famous of RAF aircraft, the D.H.9A reached France on 31 August 1918 and became standard RAF day bomber equipment and remained so for 13 years. The D.H.9A illustrated (E959) belonged to 'B' Flight of No 47 Squadron while based at Helwan, Egypt, in the mid 'twenties.



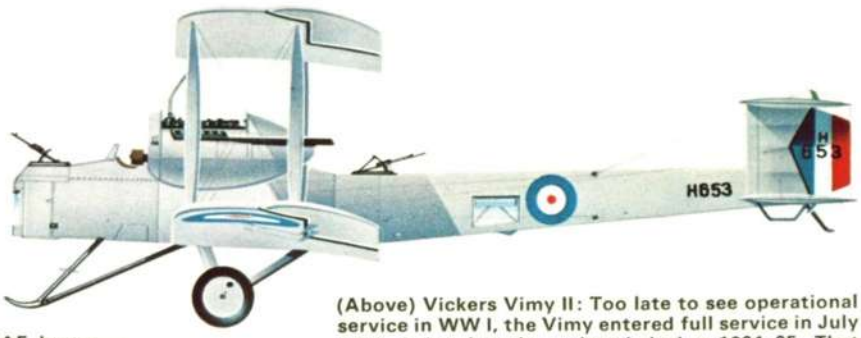
(Above) Handley Page Heyford I: Last of the RAF's biplane heavy bombers, the Heyford entered service in November 1933 and the last was withdrawn in 1939. The example illustrated belonged to No 99 Squadron, being the 12th production Mk I (K3500) based at Upper Heyford in 1934.





(Above) Fairey Battle I: Hardly the most successful of the RAF's bombers, the Battle entered service in May 1937, that illustrated (K9353) operating with No 218 Squadron in France during the German advance. (Below) Armstrong Whitworth Whitley V: A cornerstone of RAF Bomber Command in the early years of WW II, the Whitley entered service in March 1937; the Mk V illustrated (T4261) was operated from Driffield in 1940 by No 102 Sqdn.

(Above left) Handley Page O/400: The standard RAF heavy bomber at the end of World War One when it equipped seven squadrons (Nos 58, 97, 115, 207, 214, 215 and 216), the O/400 remained in service for several postwar years, that illustrated (B8811) being included on the strength of No 207 Sqdn until August 1919.



(Above) Vickers Vimy II: Too late to see operational service in WW I, the Vimy entered full service in July 1919, being largely replaced during 1924–25. That illustrated (H653) served with No 216 Sqdn in the Middle East.

(Above) Vickers Virginia VII: Serving the RAF from 1924 until 1937, the Virginia served in a variety of versions, the Mk VII (J8329) illustrated having been on the strength of No 7 Squadron at Worthy Down in 1928. Thirty-eight earlier models of the Virginia were converted to Mk VII standards and 11 new production Mk VIIs were built.

(Above) Westland Wapiti IIA: Day bomber, general-purpose aircraft and army co-operation type, the Wapiti served the RAF long and faithfully at home and abroad, being finally withdrawn in India in the early 'forties.

(Above) Hawker Hart: One of the fastest and most manoeuvrable day bombers of its era, the Hart was the progenitor of a long line of RAF bi-planes, the example illustrated (J9941) having served with No 57 Sqdn at Upper Heyford (1932–36).

(Above) Fairey Hendon II: The Hendon was the first of the RAF's all-metal low-wing cantilever monoplanes but only 14 were built for the service, these being operated by No 38 Sqdn from late 1936 at Mildenhall and then Marham until the end of 1938.

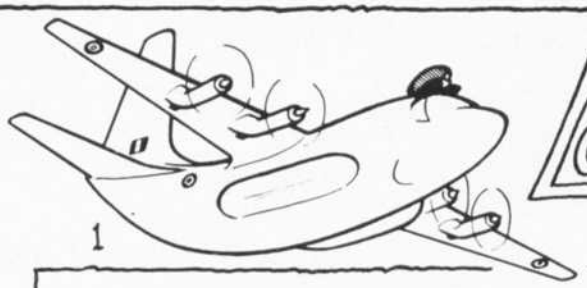
(Above) Bristol Blenheim I: An enormous technical advance when introduced in 1937, the Blenheim I illustrated (L1202) served with No 108 Sqdn at Bassingbourne in 1938. (Below) Vickers Wellington IC: The backbone of RAF Bomber Command 1940–42, the Wellington IC illustrated (R1042) operated with No 150 Sqdn from Newton in the winter of 1940–41.

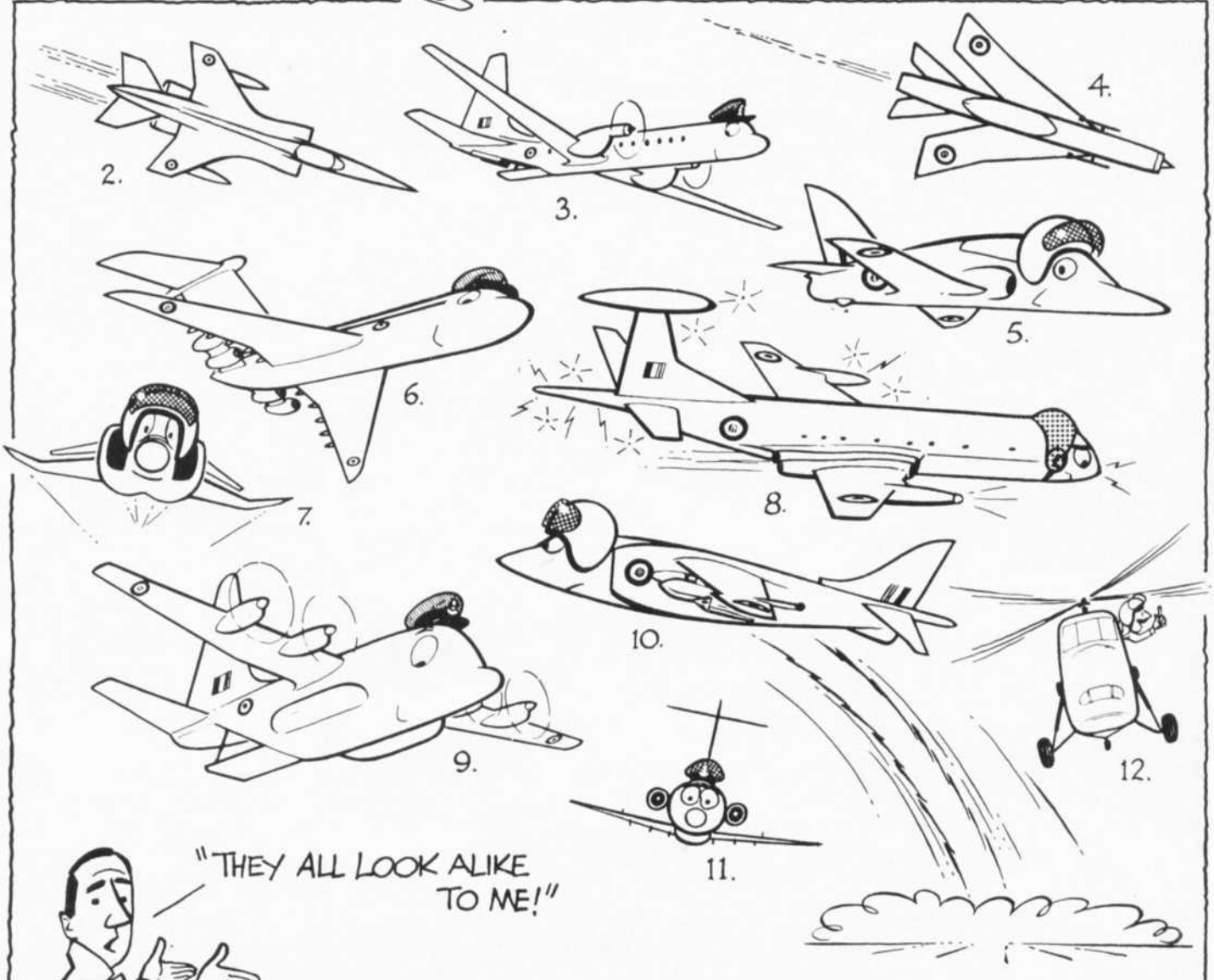
(Above) Handley Page Hampden I: The last of the pre-WW II RAF expansion plan's bomber 'twins', the Hampden (AE202) illustrated served with No 44 Sqdn.

NOT TO SCALE

Laugh with the R·A·F

—by Goren





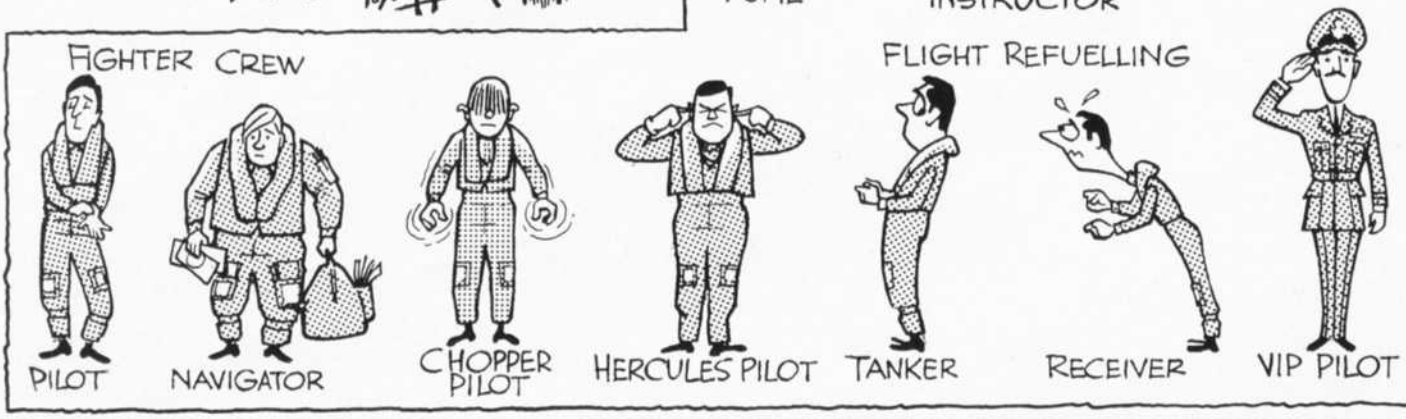
R.A.F. AIRCRAFT TYPES

1. SHORT BELFAST.
2. SEPECAT JAGUAR.
3. HSA ANDOVER.
4. BAC LIGHTNING.
5. HSA HAWK.
6. BAC VC-10.
7. McDONNELL DOUGLAS PHANTOM.
8. HSA NIMROD.
9. LOCKHEED HERCULES.
10. HSA HARRIER.
11. HSA DOMINIE.
12. WESTLAND WESSEX.

"ISN'T IT WONDERFUL HOW THE LITTLE ONES MANAGE TO KEEP UP WITH THE BIG ONES!"

"NO HOLDING SGT. NOSHER SINCE HE WON THAT INTERNATIONAL CATERING TROPHY."

R.A.F. AIRCREW TYPES



Thirty-five years ago . . .

Often over-glamorised, the Battle of Britain was a "blood-and-guts" slogging match for

AT 02.23 HOURS in the morning of 4 June 1940 the British Admiralty finally announced the completion of *Operation Dynamo* – the massive and precipitate evacuation of 126,606 British and French soldiers from the beaches of Bray-Dunes and De Panne, between Dunkirk and Coxyde. All that was left of the once-confident British Expeditionary Force, commanded by Lord Gort, was the scattered detritus of a beaten army, its accoutrements and equipment charred and abandoned in the fields behind Dunkirk.

The pace of events over the two weeks preceding the end of *Dynamo* had been almost stunning. A well-equipped and organised British army, acting in co-operation with powerful Allied forces, had been rolled up and bundled back to the sea with unparalleled efficiency. Evacuation had been carried out under the most difficult conditions. There prevailed now in the British Isles, underneath the optimism and music-hall banter, a sense of disbelief, of unreality accompanied by a growing unease – an unease that had not been experienced for several generations.

For the *Wehrmacht* and Göring's *Luftwaffe*, the tranquility of the so-called "Sitzkrieg" had turned to the fury of *Blitzkrieg* in the early hours of 10 May 1940, underscored by the rumble of Junkers troop-carriers, the throb of Heinkels and the wail of Stukas. Rotterdam, Fort Eben Emael, Maastricht, Sedan – the names are now evocative of the lightning campaign. Paris fell on 14 June. In the West the *Wehrmacht* reached the Atlantic coast and the Spanish frontier, and by 25 June the campaign had been won – with deceptive ease!

The evacuation of the French remnants and the BEF began on 26 May, protected on the ground by a series of desperate and valiant rear-guard actions, and in the air, by the Hurricanes and Spitfires of Dowding's Fighter Command, RAF. With the bombast that characterised the man, *Reichsmarschall* Göring promised Hitler that the British would be pounded to surrender at Dunkirk by his *Luftwaffe*. Accordingly, he allotted 300 medium bombers and 550 fighters of *Fliegerkorps* (FlKps) I, II, IV and VIII to the task. This move was countered with efficiency and energy by RAF Fighter Command.

In the hinterland behind the Franco-Belgian coast, hidden from the tired eyes of British soldiery on the Dunkirk beaches, the Spitfires and Hurricanes fought and held off the bulk of the *Luftwaffe*'s efforts. The battles took place well outside the range of British radar (RDF) coverage; there could be no effective fighter control for the RAF and this necessitated the use of expensive and unproductive standing patrols. On 27 May 1940, for example, sixteen RAF fighter squadrons patrolled the area, and in dogfights with the *Luftwaffe* claimed 10 enemy aircraft for the loss of 14 of their own; the following day, No 11 Fighter Group, commanded by Air Vice Marshal K R Park, MC, DFC, flew 321 sorties. The completion of the evacuation represented a month of attrition for Fighter Command, in which 100 aircraft and 80 pilots were lost. Consequently by the beginning of June, the operational fighting strength of the Command was at its lowest ebb. Every squadron, save three held in reserve within No 13 Group's northern confines, had been committed to the Dunkirk fighting, and on the morning of 5 June, Fighter Command's operational strength stood at a humbling 466 aircraft fit for action, of which only 331 were Spitfires and Hurricanes. After the rationalisation of losses, completed by 18 June, Dowding could count on 1,094 pilots – a deficit of 362 below the planned minimum establishment.

For numerous political and military reasons, Fighter Command was now granted a month of respite, in which the level of *Luftwaffe* activity was low. There was no doubt in the minds of British commanders that they would have to face a major air offensive, followed by invasion itself. This vital month was therefore used to significant effect: squadron establishments were strengthened, despite the critically depleted states of many, to a barely acceptable level; efforts were made to increase the output of trained pilots along with the transfer to Fighter Command of pilots from the RN and other Commands. In the technical field, the Spitfires and Hurricanes were fitted with two-speed variable-pitch propellers, which in the case of the Spitfire, raised its service ceiling by 7,000 ft (2 135 m), while the radar network was reorganised and steps taken to speed up introduction of Chain Home Low equipment. These provisions were by no means completed over night, but the period of comparative peace during June and early July allowed much to be started or put into effect.

A directive by *Feldmarschall* Wilhelm Keitel, the German C-in-C, of 12 July confirmed that lack of German supremacy at sea would of necessity be substituted by supremacy in the air if an invasion of Britain was to be successfully launched. As the *Blitzkrieg* format had applied to Poland, Belgium, Holland and France, so the same powerful thrust of ground forces aided and supported by overwhelming air power would apply to Britain. It was acknowledged that the Royal Air Force would offer stiffer opposition than that previously encountered and for this reason the time required for its subjugation would be longer than the 12–48 hours previously allotted.

The *Luftflotten* 2 and 3, under Kesselring and Sperrle respectively, would be charged with the launching of the major air offensive, assisted by Stumpf's *Luftflotte* 5 based in Denmark and Norway. The *Luftflotten* 2 and 3 would be concentrated in Belgium, Holland and Northern France, and on 17 July 1940 the actual strength controlled by these two formations consisted of 1,200 Dornier and Heinkel bombers, 280 Ju 87 dive bombers, 769 Messerschmitt Bf 109s, 220 Bf 110s and 140 *Aufklärer* (reconnaissance) aircraft. Fighter Command, on the other hand, could muster 666 combat ready fighters out of an establishment (IE) figure of 901* Spitfires, Hurricanes, Defiants and Blenheims. This was backed by a further 513 fighters, in varying states of availability, at Maintenance Units.†

For the *Luftwaffe*, the directed task was twofold: first to eliminate the RAF both as a fighting force and as a ground organisation;

** As at 13 July 1940* *† As at 12 July 1940*

THE "BATTLE" RECALLED

both sides. Here, W J A Wood tells the story of No.603 Squadron to show how it really was

secondly to strangle the logistic supply of the United Kingdom by attacking its ports and shipping. The elimination of the RAF was to be completed in two stages: at first, RAF fighter defences were to be brought to impotence south of a line London–Gloucester, followed by a staged offensive that would eventually cover all RAF fighter bases throughout England. Hand-in-glove with this would be an offensive aimed at the British aircraft industry. The attack on the RAF and the aircraft industry was planned for *Adler Tag*, 10 August 1940. Four days were expected to be needed for the destruction of RAF defences in the South while four weeks were considered enough for the remainder of the task. Invasion – codenamed *"Seelöwe"* (Sealion) – was scheduled for some time in the first two weeks of September.

The Battle Begins

Concerning the actual conduct of what was to become known as the Battle of Britain, there have been so many major works covering the day-to-day fighting that even a summary here would be superfluous. For clarity, the conduct of the Battle can be enumerated into phases, although in actuality there is little evidence to suggest that the delineation between phases was as clear cut as some would suppose.

From 25 June up to the middle of July, the *Luftwaffe* contented itself with scattered night raids on ports and the aircraft industry while, by day, mine-laying was carried out in the Channel and elsewhere. On 17 July, *Luftflotten* 2 and 3 were put on full alert and the pace of operations immediately began to quicken, to reach a crescendo on the eve of *Adler Tag* itself, which marked the launching of the full-scale offensive against the RAF defences. During this period, von Richthofen's *VIII Fliegerkorps* was entrusted with the closing of the Channel to British shipping and the Messerschmitt Bf 109s given the task of assuring local air superiority.

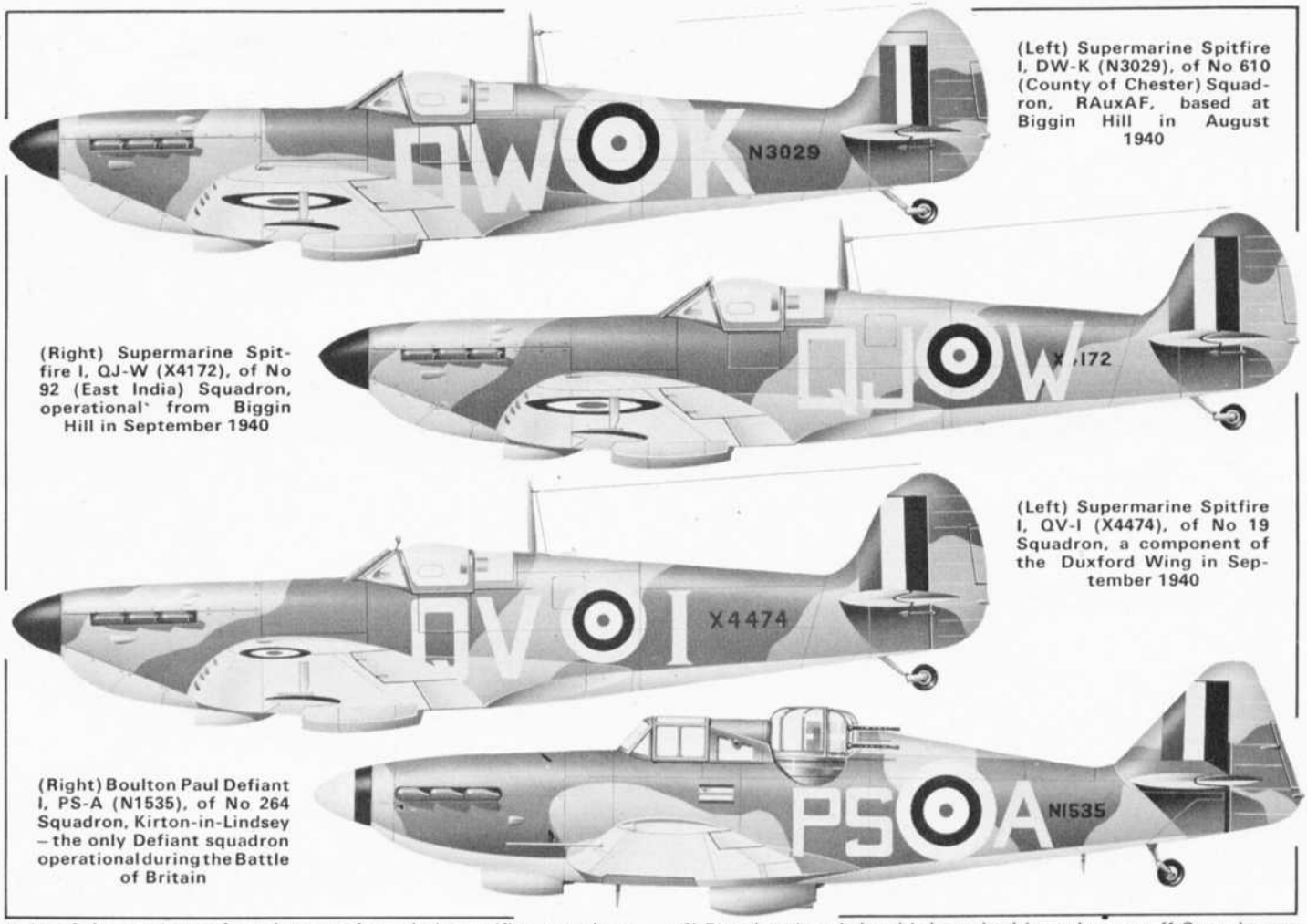
During the last two weeks of July and the early days of August, shipping and ports were attacked on a mounting scale. From this time on the Heinkel He 111s, Dornier Do 17Zs and Do 215s, and Junkers Ju 88s began to show themselves in greater strength over the Channel, Straits of Dover and the South-East of England by day. Ports and shipping were still top-priority targets, with the occasional foray against coastal airfields. It was at this stage that the *Luftwaffe* began to test the qualities of Fighter Command. Because of poor weather, *Adler Tag* was postponed until the afternoon of 13 August, when *Luftflotten* 2 and 3 flew 485 bomber sorties, covered by 1,000 fighter sorties, either as escort or roving independently on *Freie Jagd* (Free Chase) missions. The *Luftflotte* 5 entered the Battle on a full scale basis on 15 August, with diversionary attacks in the Newcastle area. On that day and during the succeeding week, the attacks against all types of airfield in the South of England were the heaviest of the Battle.

On 24 August, the *Luftwaffe* turned the whole weight of its effort against one type of target – RAF airfields and ground installations. Biggin Hill, Kenley, Eastchurch, Rochford, Hornchurch, North Weald and Debden were singled out for unremitting attention. August and early September saw massive wastage in aircraft and crews of both sides: Fighter Command suffered its heaviest losses during the bloodbath of 31 August, when 39 fighters were lost and 14 pilots killed, but for the *Luftwaffe* air supremacy in the skies over England was still a golden fleece – elusive and unattainable. Hitler intervened after an RAF raid on Berlin on 25 August, and announced his intention of making revenge bombing attacks on London. The accent was now switched from the devastating attacks on RAF installations to London itself, giving the former a respite that possibly changed the whole subsequent course of events. The decision to attack London was at least in part an admission of failure by *Luftwaffe* High Command, however, and the chances of attaining even a degree of air superiority necessary for *Seelöwe* were fast diminishing.

Losses sustained by the *Luftwaffe* during the September battles were serious, and out of proportion to the results achieved. On 27 September, new tactics were tried out in an effort to reduce losses; small groups of fast Ju 88A-1 bombers with escorts of up to 300 Bf 109Es were sent over England against selected targets. No greater success was achieved, however; *Seelöwe* was cancelled and the fate of Britain as a nation was left to the U-boat offensive and the possibility of another invasion attempt in the following summer. The use of Bf 109s as fighter-bombers, each carrying one 250-kg (551-lb) or four 50-kg (110-lb) bombs, was the final desperate attempt to force a conclusion with the RAF even if invasion was no longer possible. By the end of October, the *Luftwaffe* was glad of an excuse, provided by the cloud and squalls of Autumn, to curtail daylight operations over England, and the Battle was effectively over.

The average life expectancy of a Fighter Command pilot in this period was 87 hours flying time. Pilots who flew in the Dunkirk fighting had gained invaluable experience, as had the veterans of the AASF in France, once they had re-grouped and been re-equipped, but this core of experienced men was relentlessly whittled away. When a Squadron was withdrawn from the fighting to rest, it received new aircraft, but the replacement of pilots was less simple. If already experienced, they were tired out and had been transferred from other units, or were ex-bomber pilots; the newcomers were fresh from OTU and had as little as 10–20 hours on type. No 603 'City of Edinburgh' Squadron was an example of a fresh unit which had seen little action that could be termed demanding; confident and proficient, it was thrown into the Battle at its height. Its story, related in detail hereafter, tells all.

The *Luftwaffe* claimed 3,058 RAF aircraft destroyed in the period 10 July to 31 October: actual losses were 915. The Royal Air Force likewise claimed 2,698 German aircraft destroyed whereas the actual figure eventually proved to be 1,733. Fighter Command paid the price of 415 fighter pilots killed in combat, among them an appalling number of experienced leaders. In the



(Left) Supermarine Spitfire I, DW-K (N3029), of No 610 (County of Chester) Squadron, RAuxAF, based at Biggin Hill in August 1940

(Right) Supermarine Spitfire I, QJ-W (X4172), of No 92 (East India) Squadron, operational from Biggin Hill in September 1940

(Left) Supermarine Spitfire I, QV-I (X4474), of No 19 Squadron, a component of the Duxford Wing in September 1940

(Right) Boulton Paul Defiant I, PS-A (N1535), of No 264 Squadron, Kirton-in-Lindsey – the only Defiant squadron operational during the Battle of Britain

light of the carnage of modern warfare, their sacrifice may have seemed small when compared, for example, with the chance shell that disembowelled HMS *Hood* during her action against *Bismarck*, and killed all but three of her establishment of 95 officers and 1,324 hands. The difference lies in this: without the sacrifice of those pilots, *Hood* might well have been at sea by the end of 1940 under the flag of the *Kriegsmarine*, and the crew of *Bismarck* on shore leave in Portsmouth!

The Story of 603

Göring's air offensive against RAF Fighter Command was already in its eighth week when No 603 "City of Edinburgh" Squadron, RAuxAF, was sent south. This Squadron had been stationed within the confines of No 13 Group, commanded by Air Vice-Marshal R E Saul, DFC, whose area of operations covered Northern England and Scotland. The transfer took place on 27 August 1940, when the Spitfire Mk I fighters of No 603 Squadron flew from Turnhouse, near Edinburgh, to Hornchurch in Essex.

Hitherto, No 603 had been relatively sheltered in comparison to the harrowing ordeals experienced by other RAF fighter units in Norway, France, over Dunkirk – and now, in the lethal daily routine over the Channel and SE England. While the Squadron's Headquarters was maintained at Turnhouse, it had been customary to detach Flights to Montrose and Dyce, farther north. There had been a medium level of activity over the North Sea and Scotland, but this was as nothing compared with the events taking place in the south, and the Squadron's daily routine had been either practice missions or patrols over the eastern coast of Scotland.

The immediate adversary was *Luftflotte* 5, with approximately 190 bombers and twin-engined fighters based in Denmark and Norway. The Junkers Ju 88As of *Kampfgeschwader* 30 and the Heinkel He 111Hs of *Kampfgeschwader* 26 frequently operated over the coastal district of Scotland and often, when weather conditions were to their advantage, penetrated inland: usually these bombers operated singly, seeking targets of opportunity. There was considerable excitement on Wednesday, 3 July 1940, when No 603 Squadron shot down three Ju 88A-2s of KG 30's *8.Staffel* intercepted by Sections of the unit in separate actions. One was brought down near Montrose, the second went in 25 miles (40 km) off Peterhead and the third crashed into the sea off Stonehaven. Three days later, Plt Off G K Gilroy's Section claimed a "Do 215" 100 miles (161 km) ENE of Aberdeen (in fact this was a reconnaissance Bf 110 of the *Aufklärungsgruppe* of the *Oberbefehlshaber* [C-in-C] *der Luftwaffe*). Further isolated successes occurred on 12 July, when three Spitfires of No 603 sent a Heinkel He 111H-3 of 9./KG 26 crashing into the suburbs of Aberdeen; on 15 July, when another He 111H-3, this time from 2./KG 26, was shot down near Peterhead and on 17 July, when a third flown by *Oberleutnant* Lorenz of III/KG 26 fell to No 603 off Frazerburgh. The last interception was marred by the loss of Fg Off C D Peel, who failed to return in K9916.

Losses to the Squadron were very light during this period and interceptions often brought yet another victory. On 23 July, the Squadron accounted for a Dornier Do 17P at 1500 hours when 75 miles (120 km) East of Aberdeen, and on 30 July Flt Lt R W Rushmer's Section accounted for another of the squadron's old foes – a He 111H-4 of 8./KG 26, which went into the sea 40 miles (64 km) East of Montrose. It was a time of easy victories over relatively slow and poorly-armed Heinkels and the somewhat more formidable Junkers Ju 88s, and when the posting order to No 11 Group came through, there was much conjecture as to how the Squadron would fare in fighter-versus-fighter combats.

The Messerschmitt Bf 109E was still an unknown quantity to the pilots of No 603 Squadron. From briefs circulated by RAF Air Intelligence, they could glean its performance limitations and this information, in turn, was supplemented by discussions with battle-weary pilots from other squadrons who had been posted to the tranquility of No 13 Group for a rest. By all accounts, the Bf 109E was a *very* good aircraft: its advantages lay in its high speed, good performance above 25,000 feet (7,625 m), acceleration in a dive and the negative-g capabilities of the fuel injection system employed by its Daimler-Benz DB 601A motor. The aircraft packed two 7·9-mm MG 17 machine-guns and two Rheinmetall 20-mm MG FF cannon. Lobbing 20-mm cannon shells in air combat was a novelty at this early stage of the war, and the appalling damage caused by the thin-cased Mine round, supplemented by Incendiary and Armour-Piercing rounds, had led to the hasty addition of increased armour protection in the Spitfires and Hurricanes. The

only items that could be held against the Messerschmitt fighter were its relatively poor combat radius of action and the inferior turning performance compared with the Hurricane and Spitfire as a result of its considerably higher wing loading. The range could have been increased by use of the 300-litre (66-Imp gal) *Zusatztank* (drop-tank), but the issue of these was to be made just too late for them to be used in the Battle.

In the Spitfire Mk I, No 603 Squadron had a machine which they had quickly learned to love and cherish. Powered by the Rolls-Royce Merlin III delivering 1,030 hp and fitted with a Rotol or de Havilland constant-speed airscrew, this aircraft could attain 362 mph (582 km/h) at 19,000 feet (5 795 m). It was pure delight to fly – positive in control, a steady gun platform and capable of incredibly tight turns – in fact, the fighter pilot's dream. The 'A'-type wing, which was fitted to the Squadron's aircraft, carried eight Browning Mk II machine guns of 0·303-in (7·7-mm) calibre which fired a combination of Ball and de Wilde tracer ammunition, the latter for sighting. Each ammunition pannier carried 300 rounds, giving approximately 15 seconds of firing time. The reflector gun-sight was the Type GM 2, with adjustable ranging lines for wingspan and range. Armour plate was installed on the firewall, between the fuel tank and the engine, and behind the pilot's back and head. His face was protected by a 1¾-inch (41-mm) armour glass windscreen.

Every squadron that was equipped with the Spitfire felt supremely fortunate. The Hurricane was a different matter: its performance was markedly inferior to both the Bf 109E and the Spitfire, but in its favour was its sturdiness, manœuvrability and its ability to absorb a prodigious amount of damage and remain airborne. The Hurricane bore the brunt of the air fighting in the Battle, because of the predominant number of Squadrons equipped with this type: on 1 August 1940, no fewer than 13 of the 19 single-engined fighter squadrons operating in No 11 Group were mounted on the Hurricane. The positioning of its fuel tanks was vulnerable – particularly the 35-Imp gal (159-litre) tank mounted forward of the instrument panel which was the cause of horrifying conflagrations within the cockpit. Perhaps the most pungent remark ever made about the Hurricane came from (then) *Major* Adolf Galland, *Geschwaderkommodore* of *Jagdgeschwader* 26, who commented: "It was a nice aircraft to shoot down!"

It was, then, an eager and confident No 603 Squadron that swung its Spitfires over Upminster and raced low over the turf of Hornchurch before breaking gracefully downwind for the circuit and landing. The station was commanded by Gp Capt C A Bouchier, DFC; the other squadrons attached to Hornchurch were No 54 and No 222, these two units being on Hornchurch's satellite field at Rochford, near Southend. Squadron Leader G L Denholm was in temporary command of No 603 Squadron.

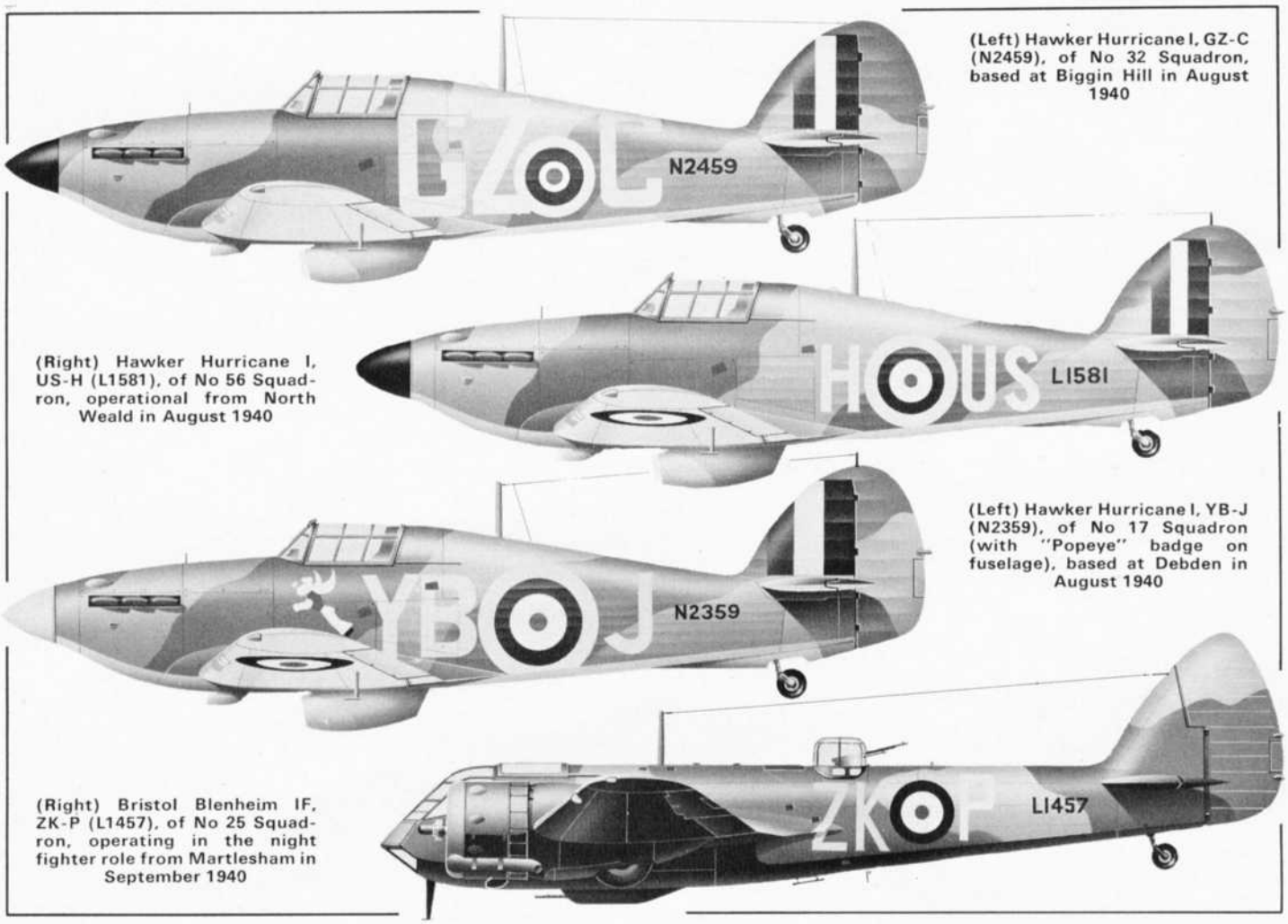
The news that greeted the pilots of the newly-arrived squadron was grim. The *Luftwaffe* seemed to have turned its attention to maximum-effort attacks on Fighter Command airfields. Manston, Hornchurch and North Weald had all been visited on 24 August (after a lull caused by bad weather) and this activity had been followed up on 26 August by more attempted raids on Hornchurch, Debden and North Weald. Moreover, the atmosphere in No 11 Group was utterly different from the relaxed surroundings north of the border – everybody was tired out and there was no light-hearted banter in the bar of the Officers' Mess. The squadron pilots received a welcome address from the Station Commander and were told that they would be given the following morning in which to settle in, but at mid-day they would be put on Readiness. Whatever happened, things were obviously to be very different from thereon in.

Within a week, the squadron was to lose four pilots killed and six wounded, and 14 Spitfires. The record of these seven days is now presented in the form of an operational diary, as an indication of the conditions that were experienced by virtually every Fighter Command unit engaged in the Battle of Britain.

WEDNESDAY 28 AUGUST 1940

Weather: Fine and fair. Cold. 5/10ths cloud over the Channel.

12.25 hours. No 603 Squadron scrambled from Hornchurch to intercept the second major *Luftwaffe* raid of the day. Thirty Dornier bombers of II and III/KG 3 flew up the Thames Estuary at 18,000 feet (5 490 m) and were over their target – Rochford aerodrome – at 1235 hours. The Squadron engaged their first



(Left) Hawker Hurricane I, GZ-C (N2459), of No 32 Squadron, based at Biggin Hill in August 1940

(Right) Hawker Hurricane I, US-H (L1581), of No 56 Squadron, operational from North Weald in August 1940

(Left) Hawker Hurricane I, YB-J (N2359), of No 17 Squadron (with "Popeye" badge on fuselage), based at Debden in August 1940

(Right) Bristol Blenheim IF, ZK-P (L1457), of No 25 Squadron, operating in the night fighter role from Martlesham in September 1940

Bf 109Es in a dogfight at 22,000 feet (6 710 m) west of Canterbury. Sq Ld G L Denholm managed to claim one as a "probable" but this was little compensation for the loss of three Spitfires in this first taste of action against the Messerschmitts of *Jafü* 2.

Flt Lt J G L Cunningham	Spitfire I	R6751	Cat 3	XT-U
Killed in combat against Bf 109s				
Plt Off D K MacDonald	Spitfire I	R6752	Cat 3	XT-E
Killed in combat against Bf 109s				
Plt Off I S Ritchie	Spitfire I	R6989	Cat 3	XT-X
Slightly wounded, baled out. Taken to Oldchurch Hospital, Romford.				

1555 hours. Scramble against a second raid on Rochford aerodrome. Again No 603 Squadron tangled with the Messerschmitts which were operating a *Freie Jagd* mission over Kent and the Estuary at 25,000 feet (7 625 m). Plt Off G K Gilroy turned in behind a Bf 109E that was firmly attached to the tail of another Spitfire. He fired all his ammunition in a single burst from 150 yards (137 m), closing to 40 yards (37 m), watched the 109 catch fire, the hood flying off and the pilot baling out NW of Dover at 20,000 feet (6 100 m). East of Canterbury, Plt Off J S Morton pulled up to attack a formation of eight Bf 109Es on his port beam. He managed to separate one of them and followed it down to 6,000 feet (1 830 m), as the Bf 109 dived across the Straits of Dover. He left it burning, still in a steep dive, at 4,000 feet (1 220 m) off Gravelines on the French coast. Plt Off R Berry also claimed a Bf 109 "probable" and one damaged. The Squadron landed without loss at 1720 hours.

1836 hours. Scramble against strong German formations approaching from the south and south-east. There were no bombers in the German formation, which consisted of five *Gruppen* of Bf 110s and six *Gruppen* of Bf 109s. At 1936 hours, amidst a wild dogfight between Manston and the Isle of Sheppey, No 603 Squadron engaged the Messerschmitts for the third time this day. Squadron Leader Denholm reported :–

"In a combat against 10 Me 109s when 10 miles (16 km) W of Manston at 20,000 feet (6 100 m) I singled out a Messerschmitt and made two stern attacks at it. After my first attack the Me 109 started to dive down. I followed it down and after my second attack, it appeared to be in difficulties. I was then able to make two quarter-attacks. The German pilot, who had been heading for France, then turned back towards the English coast and went into a glide. I eventually saw him hit some high-tension wires and crash into a field west of Dover."

All No 603 Spitfires save one were down by 2012 hours. The missing Spitfire, flown by Plt Off Benson, was found the next day and the pilot was discovered dead nearby.

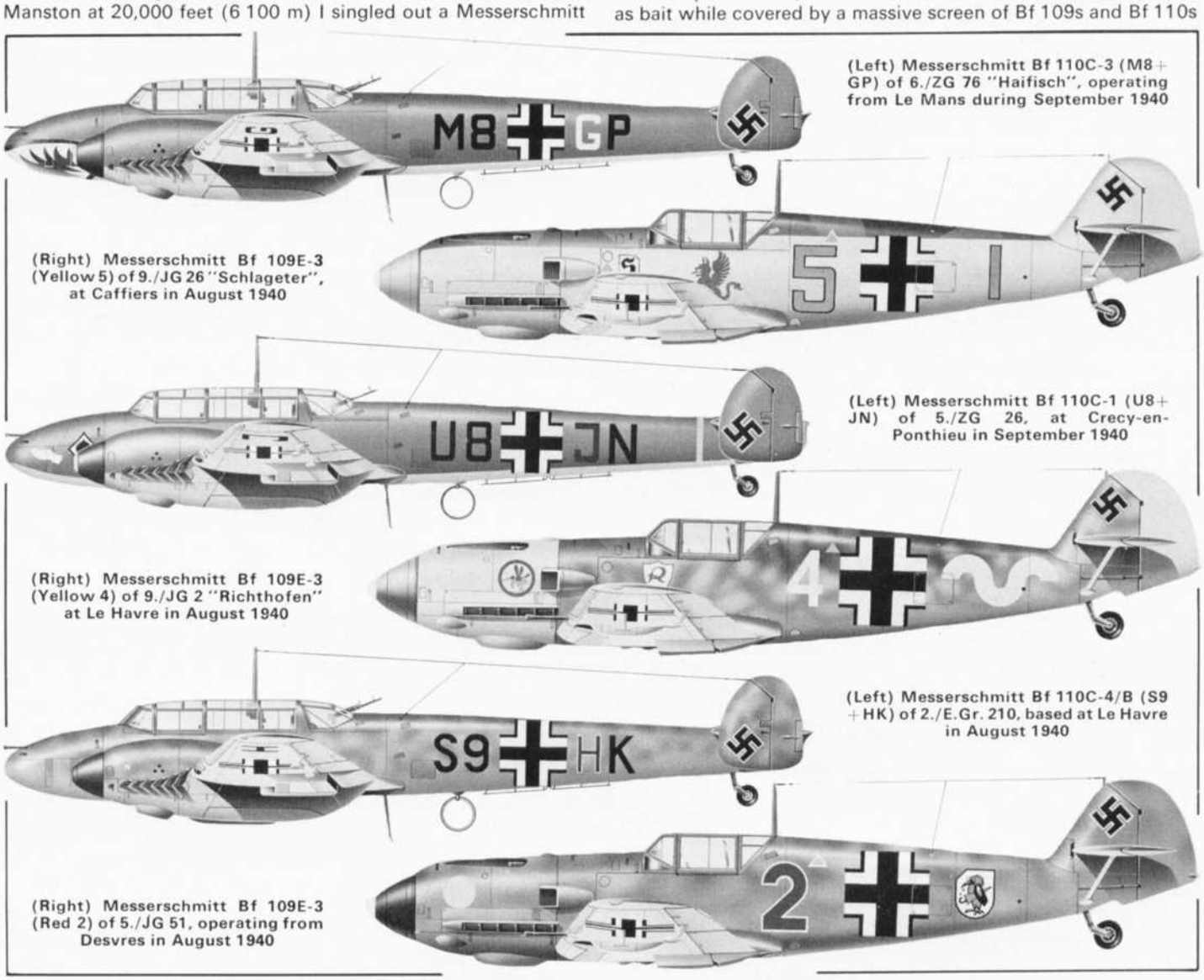
Plt Off N J V Benson	Spitfire I	N3105	Cat 3	XT-P
Killed in combat against Bf 109s				

It was an unfortunate start to No 603 Squadron's operational début in 11 Group. Most of the RAF's fighters lost this day had fallen in battles against German fighters – an expensive and unproductive exercise which constituted the very thing that Park wished to avoid. Bombers were the top priority. Against the 16 Bf 109Es lost by *Jafü* 2, Fighter Command lost 18 Spitfires and Hurricanes Cat 3 (destroyed) and a further two were Cat 2 (badly damaged).

THURSDAY 29 AUGUST 1940

Weather: Showers and bright intervals: 8/10ths cloud over the Channel.

This morning was quiet. During the night the *Luftwaffe* bombed Liverpool and battle repairs and turn-rounds took most of the morning. For No 603 Squadron, losses in Spitfires of the previous day were made good while the pilots revised tactics in the light of yesterday's costly operations. The weather brightened after lunch and towards 1500 hours, RDF plotted the first raid forming over Cap Gris Nez, Boulogne and the Somme Estuary. As a precaution, Park ordered off nine squadrons to join the four already airborne. It was a trap. This time, a few Heinkels and Dorniers were employed as bait while covered by a massive screen of Bf 109s and Bf 110s



(Left) Messerschmitt Bf 110C-3 (M8+GP) of 6./ZG 76 "Haifisch", operating from Le Mans during September 1940

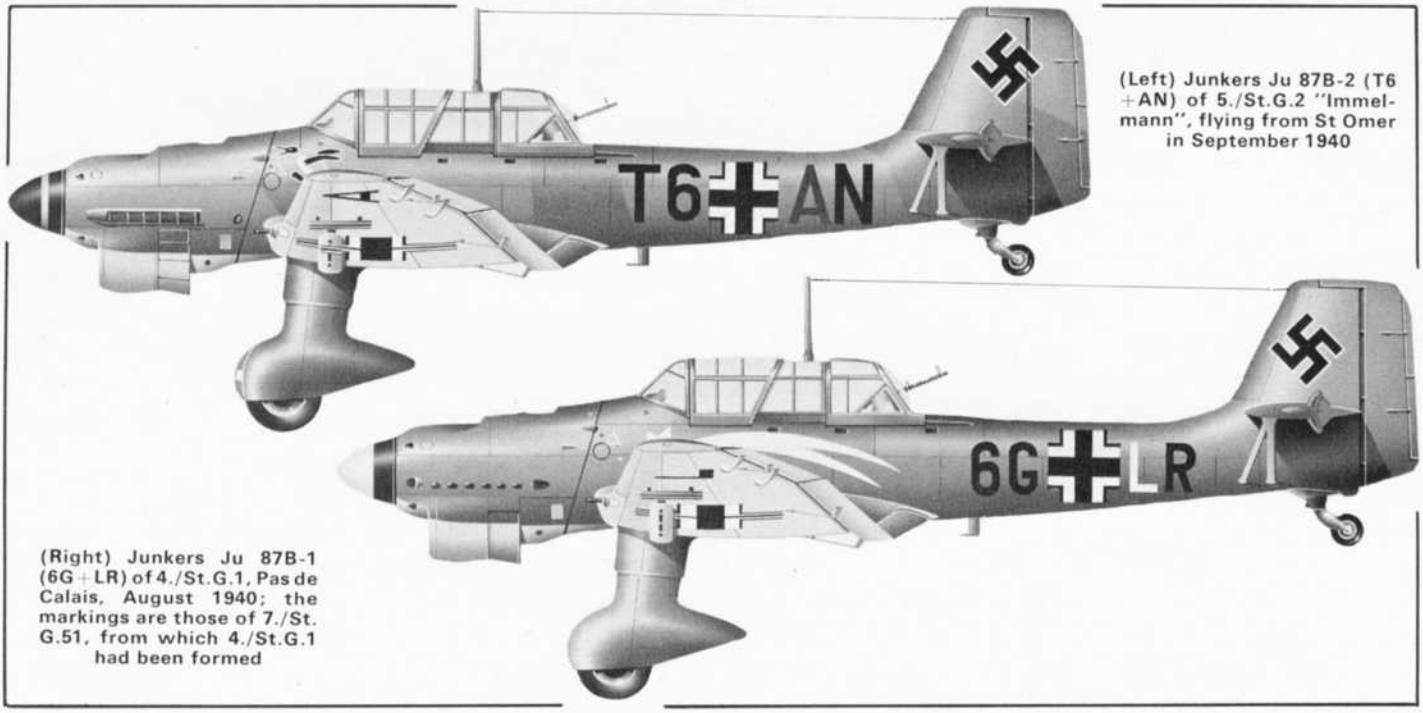
(Right) Messerschmitt Bf 109E-3 (Yellow 5) of 9./JG 26 "Schlageter", at Caffiers in August 1940

(Left) Messerschmitt Bf 110C-1 (U8+JN) of 5./ZG 26, at Crecy-en-Ponthieu in September 1940

(Right) Messerschmitt Bf 109E-3 (Yellow 4) of 9./JG 2 "Richthofen" at Le Havre in August 1940

(Left) Messerschmitt Bf 110C-4/B (S9+HK) of 2./E.Gr. 210, based at Le Havre in August 1940

(Right) Messerschmitt Bf 109E-3 (Red 2) of 5./JG 51, operating from Desvres in August 1940



(Left) Junkers Ju 87B-2 (T6 + AN) of 5./St.G.2 "Immelmann", flying from St Omer in September 1940

(Right) Junkers Ju 87B-1 (6G + LR) of 4./St.G.1, Pas de Calais, August 1940; the markings are those of 7./St. G.51, from which 4./St.G.1 had been formed

(150 Bf 110s of *Zerstörergeschwader* 26 and 76, and 564 Bf 109s of *Jagdgeschwader* 3, 26, 51, 52 and 54).
1515 hours. Scramble by No 603 Squadron. There followed a fight against the Messerschmitt 109s in which Fg Off J C Boulter destroyed a Bf 109E with "probables" claimed by Plt Offs Hillary, Stapleton and Read. 'A' Flight Commander was caught by the 109s, and crash-landed, sustaining slight wounds.

Flt Lt R W Rushmer — Spitfire I R6459 Cat 3 XT-N
Forced landing. Slight wounds.

Forty minutes after the last Spitfire had landed at Hornchurch, No 603 was again airborne, on this occasion against another massive German fighter sweep.
1810 hours. Scramble by No 603 Squadron. They met the 109s at 27,000 feet (8 235 m) over Manston airfield at 1850 hours and battle was joined. Plt Off D J C Pinkney claimed a 109 but was jumped from astern by a *Schwarm* and baled out. Fg Off B S G Carbury, a New Zealander, made a head-on pass at a Bf 109 which disintegrated in a shower of debris. Plt Off R H Hillary also claimed a 109 before his aircraft was hit by 20-mm shells and he was forced to put down in a field.

Plt Off D J C Pinkney — Spitfire I R6753 Cat 3 XT-G
Unhurt.
Plt Off R H Hillary — Spitfire I L1021 Cat 3 XT-M
Slight burns.

FRIDAY 30 AUGUST 1940
Weather: Sky clear.

After the *Luftwaffe* had conducted some shipping attacks in the Channel, RDF plotted a raid forming up in the Cap Gris Nez sector at 1030 hours. This developed into three separate waves of German aircraft, totalling 100, which crossed the Kent coast from three sides. The first wave was a fighter sweep by a *Gruppe* of Bf 109s, about 60 aircraft, which remained untouched. The second wave consisted of 40 Heinkel He 111s, 30 Dorniers escorted by 60 Bf 109s and 30 Bf 110s, converging on Kent. The haze layer which extended to 7,000 feet (2 135 m) confused the Royal Observer Corp sightings and the order to scramble for Park's squadrons was tardy.
1035 hours. No 603 Squadron scramble. They met an estimated 80 Bf 110s over Dover at 17,000 feet (5 185 m) and attacked. The Messerschmitts split up into four huge defensive circles – each of about 20 machines – and gradually spiralled down. Only Plt Off Morton managed to claim a "probable". The acting CO of No 603 was shot down, Fg Off R Mc G Waterston returned to Hornchurch with a punctured oil tank, and the Spitfire flown by Sgt A R Sarre returned with most of its tail unit shot away.

Sqn Ldr G L Denholm — Spitfire I L1067 Cat 3 XT-D
Baled out unhurt in cambat against Bf 110s.

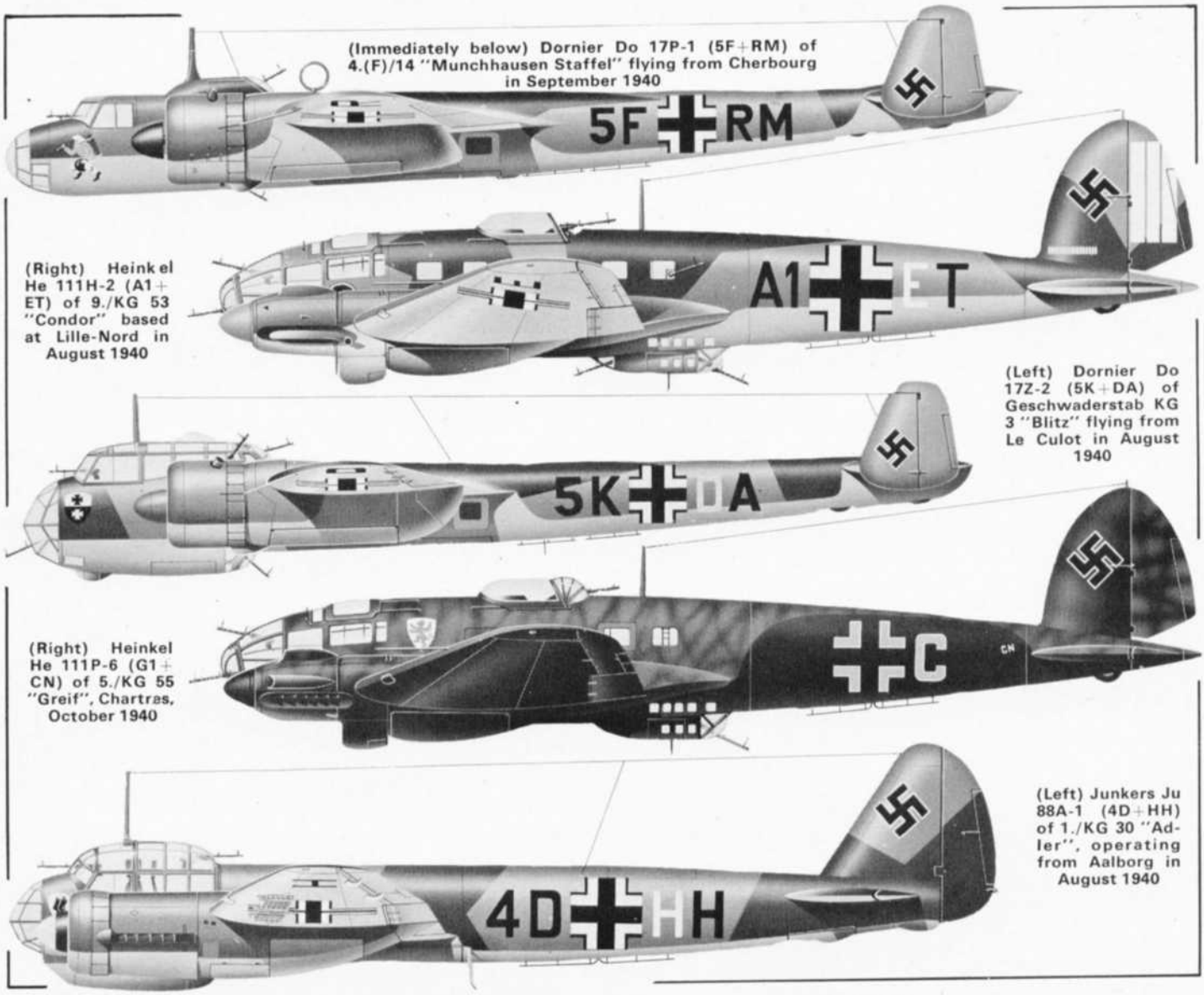
The air raid situation over Kent had become confused by 1145 hours, and combats took place over Kent for most of the afternoon. No 603 was again scrambled.
1555 hours. No 603 Squadron scramble. This was vectored on an out-going raid that had attacked Shoreham, Kenley, Tangmere and Biggin Hill. North of Canterbury they sparred with Bf 109s at 25,000 feet (7 625 m). Fg Off Carbury closed within 50 yards (46 m) of a Messerschmitt – one of three – and fired, at the same time keeping a wary eye on the German leader and his *Rottenflieger* who split in opposite directions and came around on his tail. Carbury's Bf 109 went down trailing glycol with its propeller stationary before the New Zealander had to break. A Bf 109 attacked by Plt Off Waterston was from the same group. After a starboard quarter-attack, he watched it catch fire and enter a plummeting dive, crashing into the Medway. Sergeant Sarre, already shaken from his close call of the morning, had to bale out from his spinning aircraft after the entire tail unit had been blown off by a hail of Oerlikon fire.

Sgt A R Sarre — Spitfire I R7021 Cat 3 XT-X
Baled out, Unhurt.

It had been a day of maximum effort for both the *Luftwaffe* and RAF Fighter Command: 1,054 operational sorties had been launched by the Royal Air Force against the *Luftwaffe*'s 1,345. No 603 had fared lightly in view of the overall losses of Fighter Command which had totalled 25 machines, although 15 pilots who had been shot down were saved or unhurt. One squadron from Hornchurch, No 222, had lost no fewer than eight Spitfires in the course of the day.

SATURDAY 31 AUGUST 1940
Weather: Anti-cyclonic conditions with haze.

Another day of maximum effort, resulting in the highest operational losses in pilots and aircraft suffered by RAF Fighter Command. The first reports of enemy activity on a large scale came shortly after 0800 hours. Radar stations in Kent reported four waves of German aircraft; one approached Dover while the other three swung East and then flew up the Thames Estuary. Visual sightings by the ROC confirmed that this was another major *Freie Jagd* by *Jafü* 2's Messerschmitt 109s. The re-call to the RAF fighter squadrons already airborne came too late and several large dogfights took place over Kent and the Estuary.
0855 hours. No 603 Squadron scramble. The Squadron claimed three Bf 109Es destroyed for no loss.
1240 hours. No 603 Squadron scramble. Vectored against two waves of Heinkels and Dorniers with an escort of Bf 109s and Bf 110s heading for the airfields at Croydon and Biggin Hill. Most pilots of the Squadron engaged the Bf 109s although several *claimed* kills against "Heinkel He 113s"; an erroneous designation for a fighter (He 100) which never saw front-line service with the *Jagdgruppen*! No 603 Squadron claimed seven enemy aircraft destroyed in a brawl that commenced over Biggin Hill and spread out over the Thames Estuary. Both Fg Off Carbury and Plt Off R Berry claimed two Bf 109s apiece.



(Immediately below) Dornier Do 17P-1 (5F+RM) of 4.(F)/14 "Munchhausen Staffel" flying from Cherbourg in September 1940

(Right) Heinkel He 111H-2 (A1+ET) of 9./KG 53 "Condor" based at Lille-Nord in August 1940

(Left) Dornier Do 17Z-2 (5K+DA) of Geschwaderstab KG 3 "Blitz" flying from Le Culot in August 1940

(Right) Heinkel He 111P-6 (G1+CN) of 5./KG 55 "Greif", Chartres, October 1940

(Left) Junkers Ju 88A-1 (4D+HH) of 1./KG 30 "Adler", operating from Aalborg in August 1940

1751 hours. No 603 Squadron scramble. The third hectic combat of the day. Fg Off Carbury again claimed two Bf 109s destroyed in a combat that started at 25,000 feet (7 625 m) over Southend at 1825 hours. His first went down in flames; the second crashed into a large wood. Carbury was then attacked from astern by a Messerschmitt and was slightly wounded by 20-mm shell splinters which also put the pneumatic system of his Spitfire (R6835) out of commission. Pilot Officer 'Razz' Berry engaged a single Bf 109 at 1,000 feet (305 m) off Shoeburyness at 1845 hours. Oxygen failure had forced him to leave the climbing squadron and descent was made to low level where he hoped to catch stragglers. He patrolled for almost 30 minutes before making contact – a Messerschmitt far from home and hell bent on returning there. Berry operated his boost-override switch, which enabled him to use +12 lb (5,4 kg) boost and 3,000 rpm. The Spitfire (R6626) leapt forward, and he slowly overhauled the 109, opening fire from 100 yards (90 m) astern in bursts of 3 and 5 seconds and finally closing to 10 yards (9 m) behind the frantically jinking German fighter. Both aircraft were doing about 345 mph (555 km/h) in level flight, when Berry's 0·303-in (7,7-mm) bullets shattered the 109's radiators and it began to leave the tell-tale banner of glycol vapour. The Messerschmitt went into a steep turn and finally slithered to a stop after the pilot had banged it down on the mudflats off Shoeburyness.

Two Spitfires failed to return from the fight. Plt Off Gilroy was shot down but managed to bale out. Already wounded by shell splinters, Gilroy received bad treatment from the local Home Guard, who threatened to lynch him before he could prove his identity.

Fg Off R Mc G Waterston Spitfire I X4273 Cat 3 XT-K
Killed in combat with Bf 109s over Ilford.
Plt Off G K Gilroy Spitfire I X4271 Cat 3 XT-N
Wounded. Baled out. Taken to King George V Hospital, Ilford.

SUNDAY 1 SEPTEMBER 1940

Weather: Cloud patches in morning, clearing later.

The first signs of activity came at 1015 hours, when RDF plotted formations of 20+, 30+ and 12+ forming up over the French coast. Once assembled, this raid developed into 11 formations, totalling 120 machines, which made landfall at Dover and split up to attack Biggin Hill, Eastchurch, Detling and Tilbury Docks. A second attack against the same targets followed at 1300 hours. No 603 Squadron was airborne to meet the third incursion of 50+ against Lympne and Hawkinge, accompanied by a fourth wave which attacked Detling.

Airborne at 1545, Sgt J Stokoe of No 603 was the only pilot of the Squadron to make a claim this day. At 1630 hours he engaged a single Bf 109 when south of Canterbury at 3,000 feet (915 m). He reported . . .

"We were patrolling Manston at 12,000 feet (3 660 m) when Control informed us that Canterbury was being dive-bombed. About 3 miles south of the town, when at 3,000 feet (915 m), a Messerschmitt 109E painted silver with large black crosses, went past my nose, flattened out about 50 feet (15,2 m) above me and headed south. I executed a steep turn, pushed my boost into override and sat on his tail.

"At about 50 yards (45 m) from him, I gave him a one-second burst with little effect and then closed to 30 yards (27,5 m) to give him a slightly longer burst. Black smoke poured from him as I overshot. The aircraft crashed in a field, turned over two or three times and then burst into flames against a clump of trees.

Plt Off P M Cardell Spitfire I P1030 Cat 3 XT-L
Crash-landing after combat. Pilot unhurt.

MONDAY 2 SEPTEMBER 1940

Weather: Fine and warm with early morning mist and fog patches.

No 603 Squadron was scrambled three times this day. The *Luft-*

waffe made an early start. By 0715 hours, approximately 40 German bombers and their attendant fighters were milling around in the haze above Blanc Nez; they set course at 12,000 feet (3 660 m) above Gris Nez with the Messerschmitts stacked up to 20,000 feet (6 100 m). After crossing the English coast, the force split up and separate formations made their way to Eastchurch, Rochford, North Weald and long-suffering Biggin Hill. Eleven fighter squadrons were scrambled but only five of these made contact.

0728 hours. No 603 Squadron scramble. Fierce dogfights in which Bf 109s were claimed destroyed by Plt Offs Berry, Hillary and Haig; Fg Off Carbury also claims a Bf 109 destroyed. Sergeant Stokoe of 'A' Flight encountered a gaggle of 50 Dorniers and Bf 110s at 0815 hours when north of Hawkinge. The twin-engined Bf 110s fought back and Stokoe had to break off when 7·9-mm bullets obscured his armoured windscreen. He did a tight spiral dive to 1,000 feet (305 m) and returned to Hornchurch.

1208 hours. No 603 Squadron scramble. German bombers covered by 250 fighters approached the Isle of Sheppey and the Thames Estuary before the customary split. One formation of Dorniers went for Debden aerodrome which sustained serious damage. Flt Lt Rushmer claimed a Do 17 destroyed while Plt Offs Hillary and Morton shot down a Bf 109 apiece.

1604 hours. No 603 Squadron scramble. Vectored to a large raid over Dungeness. Two Bf 109s claimed as probably destroyed by Plt Offs Hillary and D Stewart-Clarke.

Sgt J Stokoe — Spitfire I N3056 Cat 3
Shot down by Bf 109s. Taken to Leeds Castle Hospital, Maidstone.

Such was the pace and ferocity of the Battle at this stage that the dates and times of casualties sustained by RAF squadrons were often erroneous. There were several instances of casualties being listed a day after the events happened. In the case of Sgt. Stokoe, news of his circumstances and whereabouts did not reach the Squadron until 6 September.

TUESDAY 3 SEPTEMBER 1940

Weather: Fine and warm with haze in the Channel area.

The usual build-up began shortly after 0800 hours. The targets were airfields. The German force delayed its approach for an unusual length of time, thereby allowing three squadrons of RAF fighters to be in the Dover area in good time. When it was reported that the first formation consisted of Bf 109s, these squadrons were ordered to disengage and fly north. Raid 45, consisting of 54 Dorniers escorted by about 80 Bf 110s, approached the Estuary at 20,000 feet (6 100 m). The British controllers ordered all remaining squadrons to the area while they anxiously watched and awaited an indication of what was the selected target. At 0945 hours the raid turned north, crossing the northern shore of the Thames and making directly for North Weald. Unimpeded by RAF fighters – for the controllers had waited too long – the Dorniers carried out an immaculate pattern-bombing attack on North Weald from 15,000 feet (4 575 m).

No 603 Squadron had been scrambled from Hornchurch at 0915 hours and was attacked by a *Staffel* of Bf 109s as it ascended through 20,000 feet (6 100 m), east of Manston. Plt Off B J Stapleton, a South African, succeeded in penetrating the fighter screen and claimed a Do 17 bomber while Plt Offs Caister and Pease both claimed Bf 109s destroyed. Another pilot – Plt Off Richard Hillary – also claimed a Bf 109 but his report was destined to be completed only after weeks of agony in East Grinstead Hospital. He was one of two No 603 Squadron pilots left hanging in their parachute harnesses as their Spitfires disappeared into the haze thousands of feet below. . . .

"I took off with the rest of No 603 Squadron in a Spitfire that suffered from a damaged hood (there was difficulty in opening and closing). Twenty miles E of Margate we sighted 30 Me 109s 1,000 feet (305 m) above our level and coming straight for us. They came down and we split up. I climbed and from slightly below and to starboard opened fire with a three-second burst on a 109 at 300 yards (274,5 m) range, closing to 150 yards (137 m). Bits came off but he did not go down. I continued to fire in line astern, giving him a burst of four seconds as I did so. He took no evasive action, burst into flames and spun into the sea. I was then hit from astern by an incendiary bullet. The cockpit caught fire but I could not open the hood and passed out with the heat. When I came to, I was free of the aircraft and pulled my chute to come down in the sea."

After an hour of misery, Hillary was rescued by the RNLI lifeboat, *J B Proudfoot*, on temporary duty at Margate. Despite his burns, he eventually returned to operational flying on night fighters and was killed in an accident on 8 January 1943.

Plt Off D Stewart-Clarke — Spitfire I X4185 Cat 3
Baled out. Wounded. Taken to Chelmsford General Hospital.
Plt Off R H Hillary — Spitfire I X4277 Cat 3
Baled out. Rescued and taken to Margate General Hospital.

In one week of fighting in the skies over Southern England, No 603 "City of Edinburgh" Squadron had suffered the loss of 14 Spitfires Cat 3, four pilots killed and six wounded in degrees varying from critical to superficial.

The aircraft wastage suffered by the Squadron was by no means remarkable for an operational unit at this time, but it is also a good indication of the incredible rate of attrition faced by RAF Fighter Command. If the start of the Battle of Britain is taken somewhat arbitrarily as 1 July, the total losses sustained by the Command up to and including 5 September 1940 consisted of 1,184 Cat 3 destroyed, and 423 Cat 2 repairable at an MU. Despite this, the new or refurbished fighters continued to be issued to the squadrons. In terms of pilot establishment, the Command was only 207 men below strength at the end of the period, a figure which, having regard to the losses of aircraft, is remarkably low. Statistics can be made to prove anything or nothing, however, for in the seven days commencing 1 September, the *Luftwaffe* brought about the *effective* destruction of the equivalent of seven squadrons. The human element was the one that really mattered. Several squadrons were without COs; the pilots with any combat experience were fatigued almost beyond endurance and the replacements coming in were so under-trained their chances of surviving their first sorties were negligible.

No 603 Squadron continued to take losses. Flt Lt R W Rushmer was killed and Plt Off W P H Rafter, who had been with the Squadron less than a week, was wounded during the fighting on 5 September. The following day, Plt Off J R Caister was shot down in X4260, and was picked up by the Germans in the Channel. On 7 September 1940, the Squadron lost three aircraft in forced landings, although Sqn Ldr Denholm's X4250 had taken a 20-mm shell in the port wing and was assessed as Cat 1 only. Denholm had to bale out on 15 September during a dogfight with Bf 109s; Plt Off A P Pease was killed in Spitfire X4324 on this day. The Squadron received additional personnel when 'Sheep' Gilroy was coaxed out of hospital and a No 54 Squadron pilot – Fg Off P G Dexter, DFC – joined the unit. Plt Off P Howes was killed on 18 September while nine days later Plt Off P M Cardell was lost in an incident that can only be labelled extraordinary . . .

Flying Officer Dexter and Plt Off Cardell were engaging a pair of Messerschmitts at low-level over the Channel at mid-day on 27 September: Dexter later submitted this poignant report:

"We were returning to base when I saw an Me 109 heading back towards France. I chased him and when within range fired a burst which caused him to throw out white smoke from the starboard wing-root. The Me 109 pulled up to about 500 feet (152 m) and the pilot baled out.

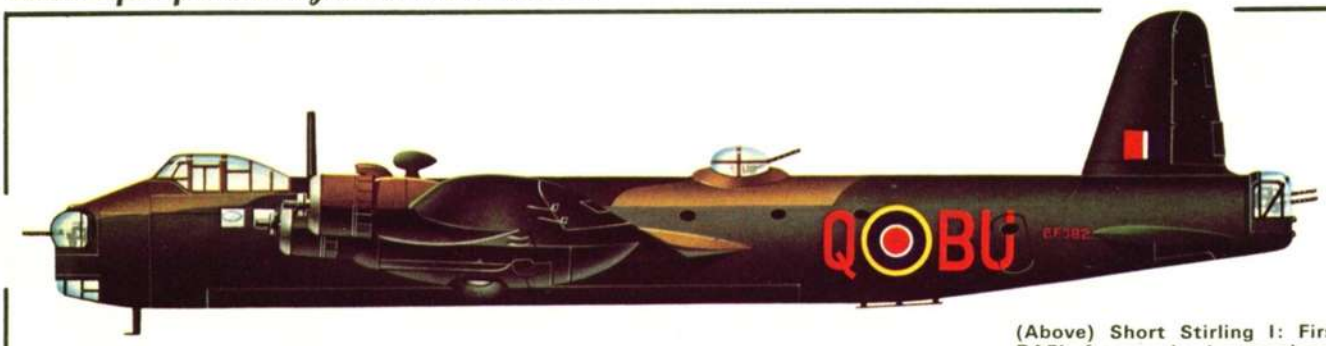
"At this time, Plt Off Cardell was in combat with another Me 109 which he destroyed. I saw it dive vertically into the sea. Five more Messerschmitts joined in, diving at us from out of the sun. After a short engagement I saw Plt Off Cardell break off and head home. While following I saw that he was having difficulties in flying his aircraft. He then jumped and opened his chute from 500 feet (152 m). The parachute failed to deploy properly and he went into the sea about ¾-mile (0,4 km) off Folkestone beach.

"I circled over the pilot for about ten minutes. No attempt whatsoever was made by the people on the beach to reach Plt Off Cardell. I then force-landed on the beach, commandeered a rowing boat, and picked him up. He had, however, by that time drowned."

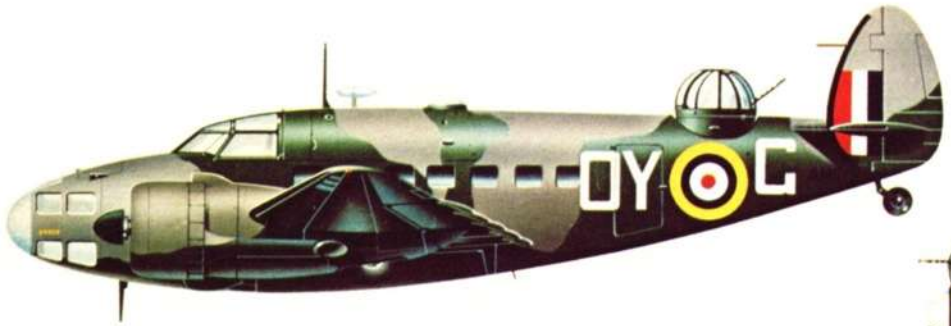
The following day Flt Lt H A J MacDonald was killed while leading No 603 Squadron into battle. And on 30 September the Squadron received Signal A236 from the Group Commander:

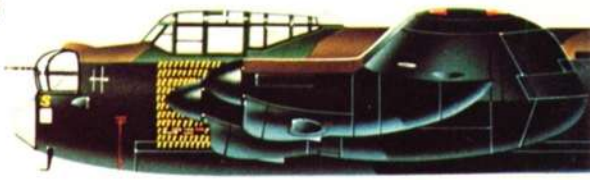
"Group Commander sends warm congratulations to 603 Squadron on their successful fighting without casualties to themselves showing exceptional leadership and straight shooting."

Park, of course, could never have made this ironic slip with intention, but it is an indication of the desperate strain that bore down on not only the operational squadrons, but the commanders themselves. The word 'without' was heavily underlined in the Squadron's operational diary in which the message had been copied, and a tired hand had scrawled an exclamation mark followed by the words "nine killed, nine wounded, one missing and one POW – in thirty days!"



(Above) Short Stirling I: First of the RAF's four-engined monoplane 'heavies', the Stirling entered service in August 1940, that illustrated belonging to No 214 Squadron. (Below right) Avro Lancaster I: Most famous of the RAF's 'heavies', the Lancaster entered service early in '42. Illustrated is R5868 of No 83 Sqdn.

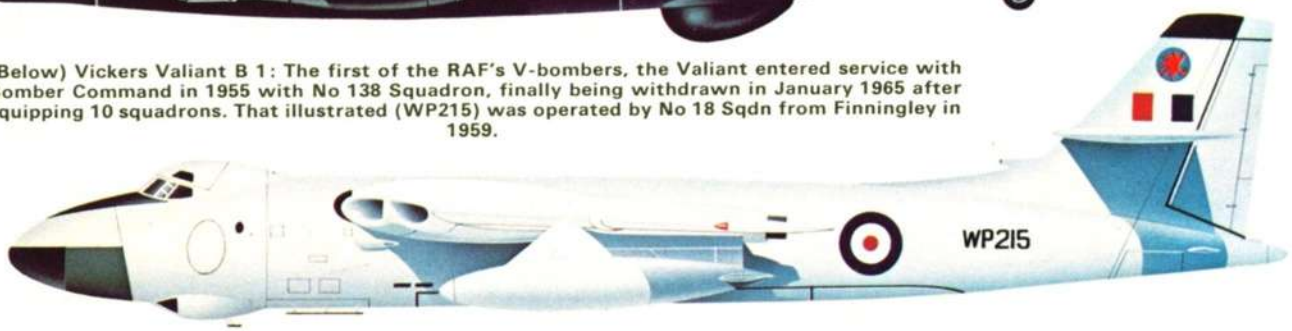




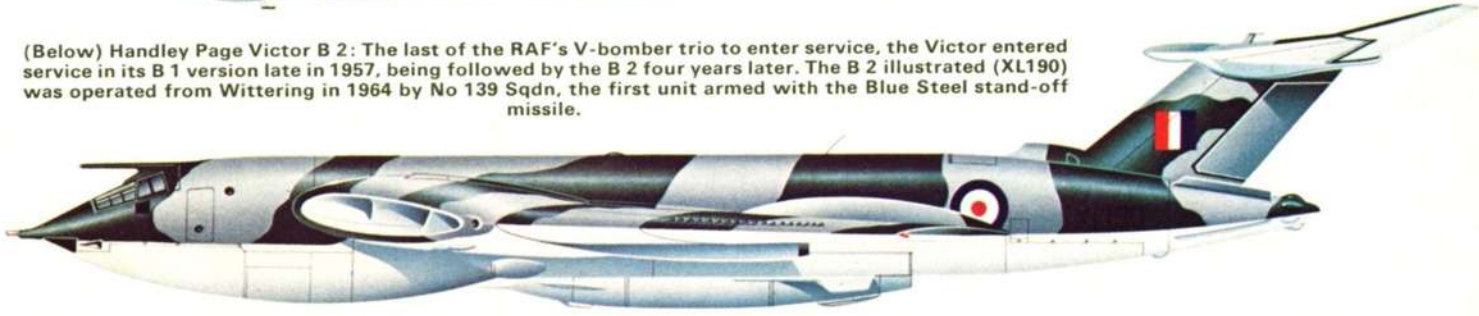
(Above) Lockheed Hudson V: The first US-built warplane to see RAF service in WW II, the Hudson reconnaissance-bomber saw extensive service with Coastal Command, that illustrated (AM578) serving No 48 Sqdn in 1941. (Below) Consolidated Liberator B VI: Used extensively by the RAF, the Liberator illustrated (KN284) served with No 356 Sqdn.

(Below) Avro Lincoln B II: The designated successor to the immortal Lancaster, the Lincoln might be considered an extrapolation of its predecessor. Too late to see WW II service, it entered service with No 57 Sqdn in August 1945, the example iillustrated (RF385) belonging to this unit and having Far East finish.

(Below) Vickers Valiant B 1: The first of the RAF's V-bombers, the Valiant entered service with Bomber Command in 1955 with No 138 Squadron, finally being withdrawn in January 1965 after equipping 10 squadrons. That illustrated (WP215) was operated by No 18 Sqdn from Finningley in 1959.



(Below) Handley Page Victor B 2: The last of the RAF's V-bomber trio to enter service, the Victor entered service in its B 1 version late in 1957, being followed by the B 2 four years later. The B 2 illustrated (XL190) was operated from Wittering in 1964 by No 139 Sqdn, the first unit armed with the Blue Steel stand-off missile.

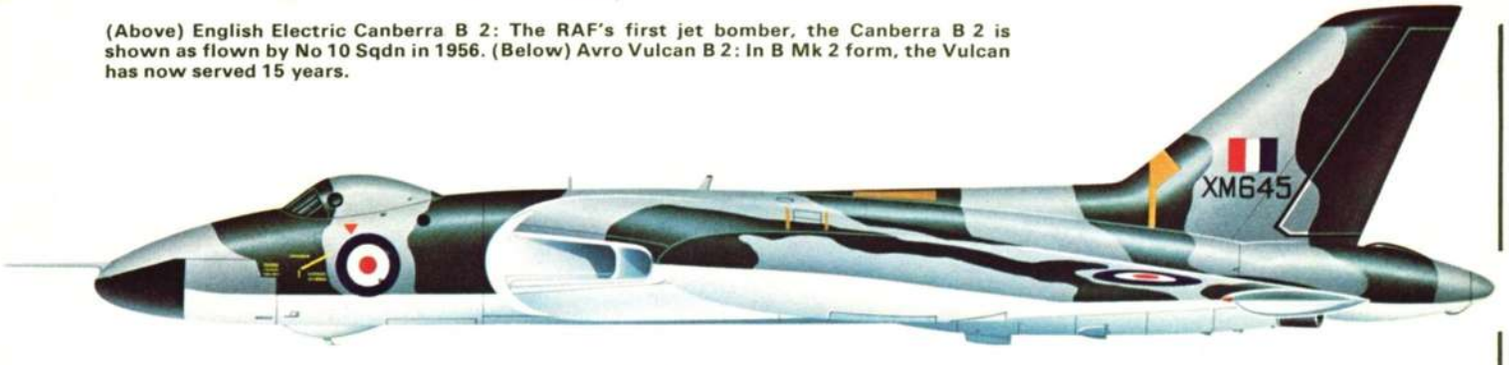


(Above) Handley Page Halifax B III: Second of the RAF's WW II four-engined 'heavies', the Halifax began sorties in March 1941. The B III illustrated (NA222) served with No 640 Sqdn in 1944–45, operating from Leconfield, Yorks.

(Above) Douglas Boston IIIA: The Boston entered RAF service in October 1941 with No 88 Sqdn, a Mk IIIA (BZ357) of this unit being illustrated. (Below) North American Mitchell II: The principal version of the Mitchell with the RAF was the Mk II, FR397 of No 226 Sqdn being shown.

(Left) De Havilland Mosquito B IV: The wooden Mosquito was one of the most outstandingly successful RAF aircraft of WW II, a B Mk IV (DZ464) of No 139 Sqdn being illustrated.

(Above) English Electric Canberra B 2: The RAF's first jet bomber, the Canberra B 2 is shown as flown by No 10 Sqdn in 1956. (Below) Avro Vulcan B 2: In B Mk 2 form, the Vulcan has now served 15 years.



(Below) Hawker Siddeley Buccaneer S 2B: Currently the RAF's most important strike and reconnaissance bomber, the Buccaneer S 2 equips four squadrons – two home-based and two in Germany – with a fifth forming. The aircraft illustrated (XW536) is operated by No 16 Squadron from Laarbruch, Germany – a component of the RAF's long-range strike/attack element.

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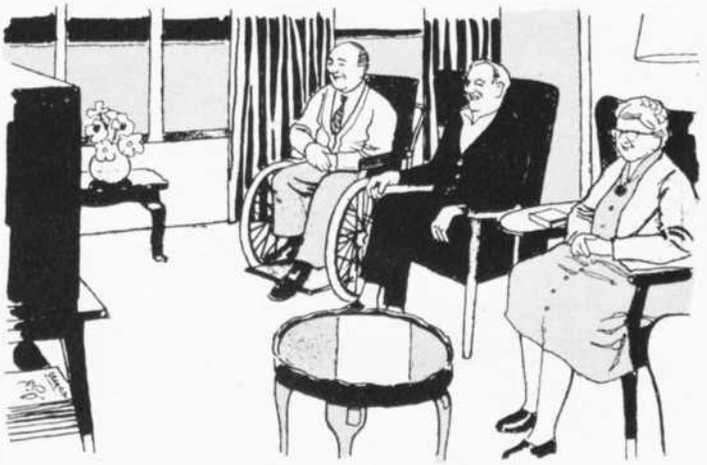

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(Above) One of the Spitfire PR Mk 19s (PM631) of the RAF's Battle of Britain Memorial Flight peels off as the unarmed Hurricane IIc (LF363) poses for the camera. (Below) The RAF's last airworthy Lancaster (PA474) in the wartime markings of No 44 Squadron

Flying Museum Pieces . . . *by John Rawlings*

GOOD AIRCRAFT NEVER DIE – – THEY SIMPLY FLY AWAY

THE JET PROVOST that had been performing aerobatics turned downwind, throttled back and lowered its gear and flaps, then swung round into a curving approach to the active runway. The crowd switched its attention to the other end of the runway in response to quite a different sound, a deep-throated roar which quickened the pulses of those "youngsters" of over forty whose memory buds were rapidly brought to life. Two purposefully-sleek shapes were bearing down on the runway, flashing past to break respectively port and starboard into climbing turns. For the next seven minutes they twisted and turned, first the Hurricane and then the Spitfire claiming the attention of the crowd as each, in turn, cavorted above the display area. Finally they rejoined downwind and curved in to land, their approach accompanied by that unforgettable popping and banging always to be associated with throttled-back Merlins. At the same time, from behind the hangars, the sound of more Merlins arose and the large black shape of a Lancaster taxied out, resplendent in the markings of No 44 Squadron, one of the first RAF units to fly this formidable World War II bomber. Having taxied to the end of the runway, the Lancaster surged forward as its four Merlins were opened up, sailing into the air to give the crowds, young and old, a nostalgic sight and sound of this most famous of RAF Bomber Command's aircraft – not just a view of one standing forever silent in a museum, but the genuine feel of a Lancaster in its element – a glimpse back to the stirring days of 30 and more years ago.

Such events, guaranteed to set the adrenalin flowing, can occur at any one of a score of flying displays held in the UK in the course of a year; the appearance at such events of the Hurricane, Spitfire and Lancaster being made possible only by the activities of the RAF Battle of Britain Memorial Flight, based at Coltishall, Norfolk. The aim and purpose of this unit is to preserve for posterity and the future these famous World War II aircraft and to re-kindle the atmosphere of those times. There are seven historic aircraft on the strength of the Flight – the Lancaster, two Hurricanes, a Spitfire II, a Spitfire V (both known on the Flight as the "baby" Spitfires) and two Spitfire PR 19s. In addition, there is a Chipmunk belonging to the Flight to enable the pilots to keep in practice on piston-engined tailwheel-type aircraft, since the airframe life of the veterans is too precious to be used for all the continuation training necessary.

From Easter to October each year, all these aircraft are fully active, flying almost every weekend at displays and sometimes during the course of the week as well, which is truly remarkable for aircraft all of which are at least 30 years old. They are flown by five pilots who fulfil this task as a secondary duty – that is to say, they all have full-time posts at Coltishall, most of the flying being performed in their spare time.

The Royal Air Force has preserved single examples of its first jet fighters, the de Havilland Vampire and the Gloster Meteor, although both are two-seat training variants of the original single-seaters, and are in Training Command colours of the mid 'sixties. The two aircraft are shown in formation over the Severn Road Bridge

HISTORIC AIRCRAFT STILL FLYING

AIRCRAFT TYPE	SERIAL NUMBER	LOCATION	REMARKS
Avro 504K	E3404	Old Warden	Owned by the Shuttleworth Collection. Restored from an Avro 504N by Avro apprentices.
Avro 504J/K	B3182	Boise, Idaho	Built 1916. Went to USA after WWI and restored to original condition 1972.
Avro 504K	G-CYFG	Rockliffe, Ottawa	Hybrid aircraft, probably re-built from A1958, A1995, A1996.
Avro 504K	G-CYCK	Rockliffe, Ottawa	Possible ex-D8971, restored at Trenton 1967.
Avro 504K	A3-4	Mascot, Sydney	Possibly ex-H2173, re-engined with Sunbeam Dyak as original QANTAS aircraft.
Avro 621 Tutor	K3215	Old Warden	Owned by the Shuttleworth Collection. Served with RAF at Cranwell CFS, I FTS, 41 & 61 OTU's & London UAS; also at Boscombe Down.
Avro Anson I	N4877	Staverton, Glos.	Owned by Skyfame. Served with RAF & ATA from 1938 until 1953.
Avro Anson I	VH-BAF	Moorabbin, Melbourne	Flying under civil marks. Originally RAF MH120.
Avro Lancaster I	PA474	Coltishall, Norfolk	Operated by the RAF B of B Memorial Flt; built at end of WWII and served in PR rôle with 82 Sqdn post-war.
Avro Lancaster X	KB976	St Albert, Alberta	Used as CF-TQC for water-bombing duties, served with 408 Sqdn post-war. Coming to Strathallan.
Avro Lancaster X	KB889	Markham, Ontario	Served briefly with 424 Sqdn in Europe.
Bristol F.2B Fighter	D8096	Old Warden	Served with 208 Sqdn in Turkish campagin in 1920s. Became G-AEPH later.
Bristol 149 Bolingbroke	9940	Auchterarder	RCAF aircraft to be restored as RAF Blenheim IV.
DH Mosquito T.3	RR299	Hawarden	Served with RAF post-war and took part in film "633 Sqdn", coded "HT:E".
DH Mosquito TT.35	RS712	Auchterarder	Strathallan Collection. Took part in "633 Squadron" film, coded "HT:N".
DH Mosquito B.35	VR796	Kapuskasing, Ontario	Being restored by Canadian Air Cadets. Ex-Spartan Air Servicees CF-HML.
DH Mosquito TT.35	N9797	Harlingen, Texas	Ex-RS709, part of the Confederate Air Force.
DH Vampire F.3	N6878D	Van Nuys, California	Ex-RCAF 17072.
DH Vampire T.11	XH304	Little Rissington	Part of CFS demonstration, flies with Meteor T7.
DH Vampire T.11	N11921	Chino, California	Based with Yesterday's Air Force.
DH Vampire T.35	N11929	Denver, Colorado	At Buckley ANG Base, ex-RAAF A79-644.
Fairey Battle	—	Auchterarder	Strathallan Collection. Ex-RCAF aircraft; being restored.
Gloster Gladiator	L8032	Old Warden	Shuttleworth Collection. Painted in 72 Sqdn insignia.
Gloster Meteor T7	WA669	Little Rissington	Part of CFS demonstration, flies with Vampire T11. Served with 203 AFS & 229 OCU.
Gloster Meteor T7	WA662	Llanbedr	Serving with RAE.
Hawker Tomtit	K1786	Old Warden	Shuttleworth Collection. Ex-RAF & G-AFTA.
Hawker Hurricane IIc	LF363	Coltishall	B of B Memorial Flt. Served in WW2 with 63, 309 & 26 Sqdns. Painted as Douglas Bader's 242 Sqdn acft "LE:D".
Hawker Hurricane IIc	PZ865	Coltishall	B of B Memorial Flt. Last Hurricane built. Painted as Stanford Tuck's 257 Sqdn acft. "DT:A".
Hawker Hurricane X	5588	Auchterarder	Strathallan Collection. Ex-RCAF acft, took part in "Battle of Britain" film. Painted as Mk I P3308 "UP:A" of 605 Sqdn.
Lockheed Hudson IV	c/n 6464	Auchterarder	Ex-VH-AGJ. To be repainted as RAAF acft.
Lockheed Hudson III	A16-122	Osborne Pk, NSW	Flying as VH-AIU
	A16-112		Flying as VH-AGS.
RAF SE 5A	F904	Farnborough	Maintained by RAE for Shuttleworth Collection.
Short Sandringham (Sunderland)	N158C	Virgin Islands	Ex-Ansett FB Services, in commercial service with Antilles Air-Boats'
Sopwith 2F1 Camel	N8156	Rockliffe, Ontario	Ex-RNAS acft.
Sopwith 1F1 Camel	B7270	Boise, Idaho	Acft which shot down Richthofen, painted in mkgs carried by 209 Sqdn's Roy Brown.
Sopwith 1F1 Camel	N6254	Santee, S Carolina	Tallmantz Collection, now part of "Wings & Wheels".
Sopwith 7F1 Snipe	E6938	Rockliffe, Ontario	Restored by Jack Canary, as "B" of 208 Sqdn.
Sopwith 7F1 Snipe	E8100	Rhinebeck, N.Y.	Cole Palen Collection, painted as "1:3" of 56 Sqdn.
Sopwith Pup	N5180	Old Warden	Shuttleworth Collection, restored from Sopwith Dove.
Sopwith Pup	N5182	Fairoaks	Rebuilt by D St Cyrien.
Supermarine Spitfire I	AR213	Booker	Air Cdre Wheeler's acft, painted in wartime marks of "QG:A", served with 53/57 OTUs.
Supermarine Spitfire IIA	P7350	Coltishall	B of B Memorial Flt. Served with 266 Sqdn in 1940 and now painted as "UO:T" of that unit.
Supermarine Spitfire V	AB910	Coltishall	B of B Memorial Flt. Serviced with 53 OTU, now painted as "QJ:J" of 92 Sqdn.
Supermarine Spitfire V	AR501	Duxford	Being restored by EAAS for Shuttleworth Collection.
Supermarine Spitfire T8	G-AIDN	Andover	Ex-MT818, prototype two-seater. John Fairey's acft.
Supermarine Spitfire F9	MH434	Booker	Adrian Swire's acft, ex-222 Sqdn, painted as "AC:S".
Supermarine Spitfire F9	N238V	Sugarland, Texas	Ex-NH238, painted as Johnny Johnson's acft, "JE:J".
Supermarine Spitfire F9	N1882	Denton, Texas	Ex-MK297, flew with 340 Free French Sqdn.
Supermarine Spitfire T9	MJ772	Auchterarder	Strathallan Collection. Ex-Irish Air Corps 2-str, flew in "Battle of Britain" film, coded "NL:R".
Supermarine Spitfire T9	TE308	Windsor, Ontario	Re-built as single-seater, coded "RA:F".
Supermarine Spitfire T9	HS543	Fort Collins, Colorado	Ex-Indian Air Force, being restored.
Supermarine Spitfire F14	RM689	Castle Donington	Ex-G-ALGT, owned by Rolls-Royce, painted as RM619 "AP:D" of 130 Sqdn.
Supermarine Spitfire F14	N5505A	Fort Collins, Colorado	Ex-TZ138, being restored.
Supermarine Spitfire F16	SL721	Blackbushe, Surrey	D Arnold's acft, painted in original trim as Air Marshal J M Robb's acft.
Supermarine Spitfire PR19	PM631	Coltishall	B of B Memorial Flt. Used in "Battle of Britain" film. Coded "AD:C".
Supermarine Spitfire PR19	PS853	Coltishall	B of B Memorial Flt. Served with 16 & 268 Sqdns in WW2. Used in "Battle of Britain" film.
Supermarine Spitfire F22	SR64	Salisbury, Rhodesia	RRAF HQ.
Westland Lysander IIIA	2355	Auchterarder	Strathallan Collection. Ex-RCAF, being restored.
Westland Lysander	1176	Chino, California	To be rebuilt, ex-RCAF, now with "Yesterday's Air Force".
Westland Lysander	N7791	Van Nuys, California	Dwight Brooks' restoration, painted (incorrectly) as "AC:B" of 138 Sqdn.
Westland Lysander	1244	Booker, Bucks	Being restored by Personal Plane Services, ex-RCAF.

This table, compiled with the invaluable help of Leslie Hunt's "Veteran and Vintage Aircraft" (Garnstone Press) lists all known airworthy aircraft of types once used operationally by the Royal Air Force, but in view of the rapidly changing restoration scene, no guarantee of complete accuracy is given. Such types as the Tiger Moth, still flying in some numbers, have not been included.

A limit has been imposed on the Flight's aircraft – 55 hours per year for the Lancaster and 200 hours per year for the single-seaters – in order to preserve them and not just flog them to death in the next half-decade or so. Flying restrictions, however, are surprisingly few, with a top speed for the Hurricanes and Spitfires of 275 knots (510 km/h) and a plus 3*g* limitation together with no negative *g* and no inverted flying. This means that aerobatics are limited to barrel rolls, but otherwise the past flying performance envelope of these types is barely restricted and a very pleasing display routine can be flown, a co-ordinated pairs routine of one Hurricane and one Spitfire being normal.

Remarkably, there is very little unserviceability during the season on these veterans and this is largely due to the fact that, during the winter months, they are completely re-worked at Coltishall. Each aircraft is given a "super major" overhaul lasting from three weeks to two months and all the components needing replacement are dealt with. Apart from the time that they are in pieces, each aircraft makes, on average, one flight a week during this off-season, for pilot familiarisation and because it is a wise maxim that the aircraft that is kept in flying trim keeps serviceable.

Obviously, the whole of this operation stands or falls by its maintenance backing. This is the responsibility of personnel taken from normal station strength and who complete a normal tour of duty with the Flight. As it involves much more weekend work than usual, it is felt important that the ground crew should not be expected – or allowed – to serve for more than one tour, the only exception being the Chief Technician who has now been with the Flight four years and who "eats, drinks and sleeps" his Hurricanes and Spitfires. The Flight has a two-ton spares holding, even including a spare Spitfire (a Mk IX) which is being cannibalised to

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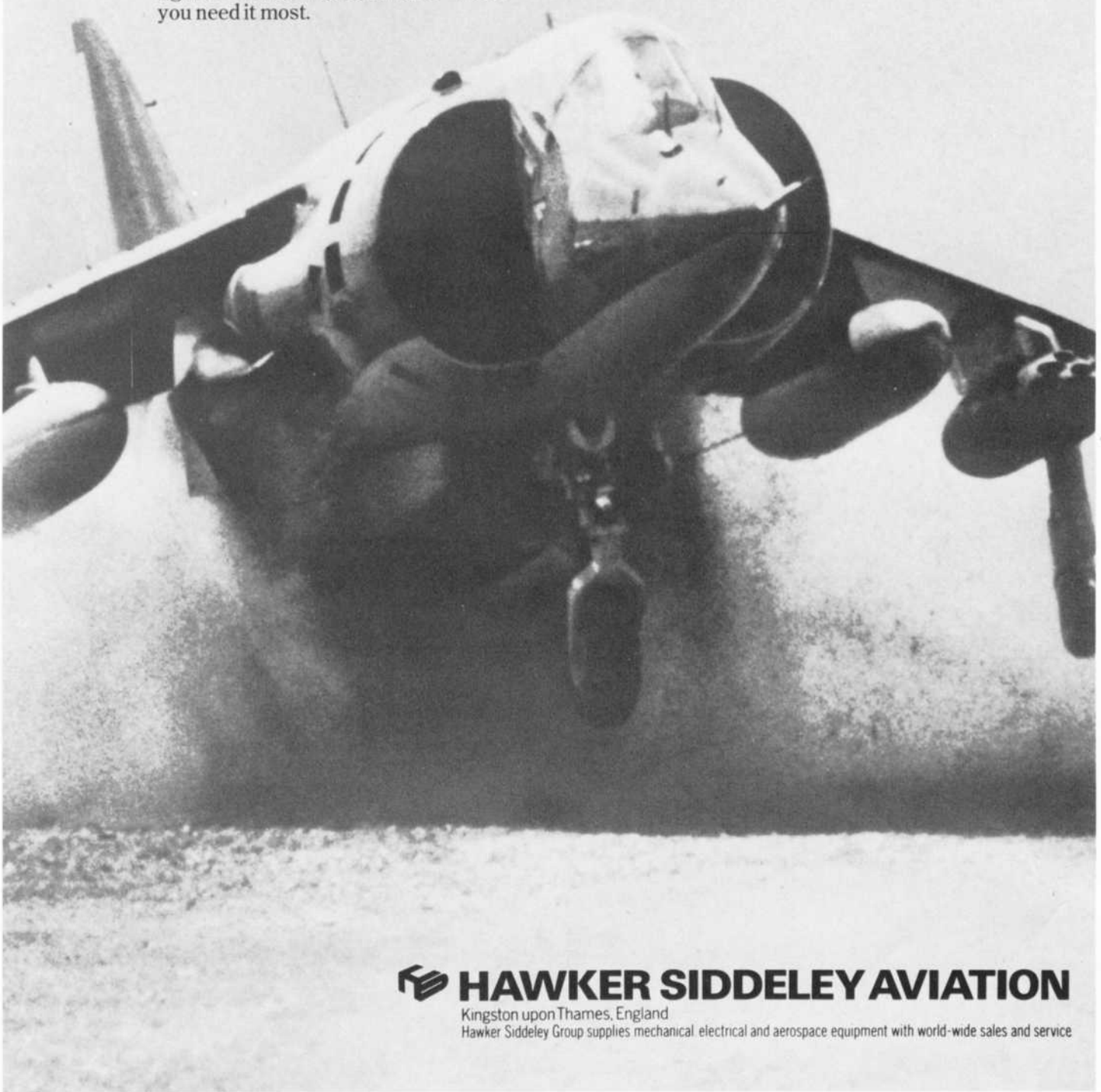

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Generally speaking, a degree or above-the-minimum qualifications will always improve your chances. Minimum age for applications is 17.

To join as an airman you need to have, or show you can learn, a skill the RAF can use. ONC, HNC etc., may or may not have a bearing on this according to the trade you are interested in, and the vacancies available when you apply. You can apply from age 16½.

To join as a Technician Apprentice, for a full-time, 3-year trade training course leading to ONC, you need, as a minimum, 4 acceptable O-levels including maths and physics (or a science subject including physics); or equivalent. Minimum age for application is 16.

Whichever way you join, one thing is certain. More than anything else, it is *your potential* that the RAF is interested in. They want you to give the very best that you are capable of; and the fact is that a lot of people just don't know what their capabilities are until the RAF discovers and develops them.

More details? Certainly. Look in the telephone book under RAF Careers Information Office, and find the address that is most convenient for you. Ring up, write, or go straight round. No obligation! *Formal application must be made in the UK.*

ROYAL AIR FORCE

keep the four other Spitfires flying. Spares are a major and ever-growing problem, and nowadays have frequently to be made on the station when they cannot be obtained from the original suppliers. In this respect, the Hurricanes are easier than the Spitfires for they belong to an earlier generation of engineering which can more easily be reproduced.

Nevertheless, it is inevitable that these aircraft have had to be modified slightly in some way or other as the original parts have disappeared; for example, the Hurricanes now use Merlin 502 engines from Yorks (a version of the Rolls-Royce engine that no Hurricane ever took into combat) and the "baby" Spitfires' Merlins are similarly non-standard Mk 35s extracted from retired Boulton Paul Balliols, but in each case the engines are of the same basic configuration as the originals. The Spitfire V has had to be fitted with a four-blade propeller which looks wrong, although, in fact, some Spitfire Vs were so fitted at the very end of the War. But the end result of all this "making do" is that thousands of people each year can see these famous old aircraft in their element, and new generations can be given a glimpse of some of the immortals in the RAF's history.

World War I Survivors, too

The aircraft of the Battle of Britain Memorial Flight may well be the best known RAF veterans still flying, but they are far from being the only airworthy survivors of an earlier age in the Service's history. The RAF itself has a Vampire and a Meteor flying from the Central Flying School at Little Rissington which, although they are post-war examples of these two types, represent the RAF's first jet fighters, which were just coming into service at the end of World War II.

At Old Warden, in Bedfordshire, the Shuttleworth Collection has some even older RAF aircraft still flying. Deservedly famed for the excellence of its craftsmanship and the patience and painstaking work that goes into the restoration of its exhibits, the Shuttleworth Trust flies its aircraft energetically at its own series of displays during the season and they are seen at other displays the year round. Shuttleworth has undoubtedly the finest collection of World War I and inter-war RAF aircraft still flying, including an Avro 504K trainer from the first conflict, an Avro Tutor trainer from the 'thirties, a Bristol Fighter from World War I which also flew in the Turkish campaign in the early 'twenties, a Gloster Gladiator from World War II, a Hawker Tomtit from the 'thirties and a Sopwith Pup from the first war. The Trust also has a Spitfire V which is being restored to flying condition by the Imperial War Museum/East Anglian Aviation Society team at Duxford and an SE 5a replica which is to be repaired at Farnborough.

Another team working on the same lines as Shuttleworth but having started more recently is the Strathallan Collection of Aircraft at Auchterarder in Perthshire, Scotland. This is already flying a Canadian-built Hurricane X painted up as a Mk I in the markings of No 605 Squadron and a two-seat Spitfire IX which was used in the "Battle of Britain" film. It has also acquired a Mosquito 35 which was used in the film "633 Squadron" and an ex-Australian Lockheed Hudson. More long-term projects in the Strathallan workshops are some airframes bought from Canada – namely a Fairey Battle, a Westland Lysander and a Bristol Bolingbroke (Canadian-built Blenheim) – all of which are to be restored to flying trim eventually.

This type of long-term restoration work has also been the speciality over many years of Doug Bianchi at Booker. His company, Personal Plane Services, maintains aircraft on behalf of flying clubs and private individuals, and is responsible for keeping many rare and historic aircraft flying, most of them outside the scope of this article. Of the RAF types, he keeps a Spitfire I flying for Air Cdre Allen Wheeler and a Mk IX for Adrian Swire, and the main project of this type now coming to fruition is a Westland Lysander. His skilful restoration engineer has been working on this aircraft, with help from another enthusiast when feasible, for about three years. Some of the parts were missing and they had to make them from scratch by examining the non-airworthy Lysander in the RAF Museum. With all these restoration projects, there are individuals and companies all over the place who assist with instruments, tyres and other parts so that eventually, after two, three or even more years work, what looked like a heap of twisted metal when it arrives in the workshops, emerges and climbs into the air again as it did twenty or thirty years ago.

Among the other organisations and individuals in this country flying old RAF aircraft are Hawker Siddeley Aviation, with a Mosquito III which flies from Hawarden; John Fairey, who flies his two-seat Spitfire VIII (actually the prototype two-seat Spitfire) from Andover and Douglas Arnold with a Spitfire LF Mk 16 (once used by Air Vice-Marshal J M Robb) flying from Blackbushe. Desmond St Cyrien took 16 years to restore a Sopwith Pup (75 per

(Below) The only Westland Lysander airworthy in 1975 was this example (originally built in Canada for the RCAF) lovingly restored in California by Dwight Brooks, an ex-USAF jet pilot. (Above right) This all-yellow Avro Tutor is one of several airworthy ex-RAF types maintained by the Shuttleworth Collection at Old Warden

Typical of many former RAF aircraft that were sold for civil use and have subsequently been repainted in wartime colours are (left) this de Havilland D.H.89A Dominie and (right) a Miles M.14A Magister. The Dominie was once used by BEA and was flown to California, its present home, several years ago

cent original) to flying trim at Fairoaks – but this is not quite an RAF veteran, since it dates from Royal Flying Corps days!

RAF veterans are not restricted to the United Kingdom – they can be found all over the globe and especially west of the Atlantic. For example, Canada boasts two flying Lancasters, both ex-RCAF machines which were in operational use long after the RAF's own Lancasters had been retired, and one of which is to be flown over to join the Strathallan collection; and there are no fewer than seven flying Spitfires in the USA and Canada. North America is the land of Sopwiths, too, for there are two Sopwith Camels in the USA and one in Canada, and one Snipe in each country. Dwight Brooks at Van Nuys Airport, California, has recently restored an ex-RCAF Lysander, this, too, being a three-year effort which involved, he says, 350 letters, 500 'phone calls and 27,000 miles of travelling by road and air before he could even start the serious work. This gives some idea of the dedication (and expense!) required to put one of these oldies back into the air again – but no-one who has read Brooks' account of his first flight in the restored Lysander can be left in any doubt as to the thrills that await the restorer with enough patience and cash to see the job through. The old World War I Avro 504K flies again in the New World with one each in Canada and the USA; there are Mosquitos, too, one with the Confederate Air Force at Harlingen, Texas and one reported as being restored to flying condition by Air Cadets at Kapuskasing, Ontario. A single-seat Vampire F Mk 3 flies at Van Nuys and a two-seater at Denver, Colorado.

The other side of the world can produce a few flying RAF specimens, such as an Avro 504K at Sydney, in Australia, and an Anson at Moorabbin. Hudsons still take the air in Australia and, so it is said, a Spitfire 22 flies in Rhodesia whilst two Short Sandringham flying boats (ex-Sunderlands) still ply a commercial route in the Caribbean.

Altogether there are many hundreds of wartime trainer and communications aircraft still flying throughout the world; Tiger Moths, Dakotas, Harvards, Ansons, Proctors and Magisters among them. Still serving a useful purpose and not just "flying museum pieces", these are outside the compass of this article, interesting though they are. But certain it is that the hard-working efforts of countless "restorers" and "maintainers" the world over, spurred on by their love of these old aircraft, have already provided pleasure to many thousands of spectators and ensure that this aspect of the history of the RAF will be preserved, not simply in dusty archives or museums but in the sight, sound and smell of aircraft living in their natural environment.

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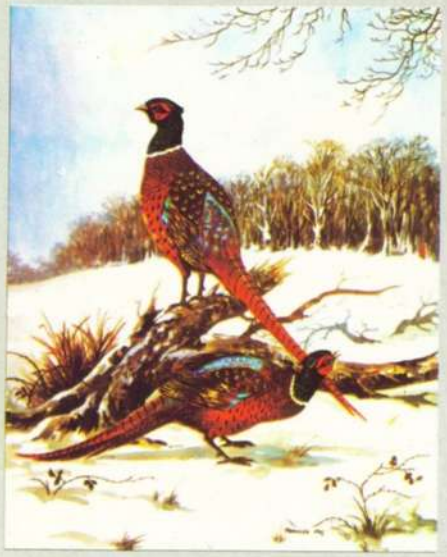

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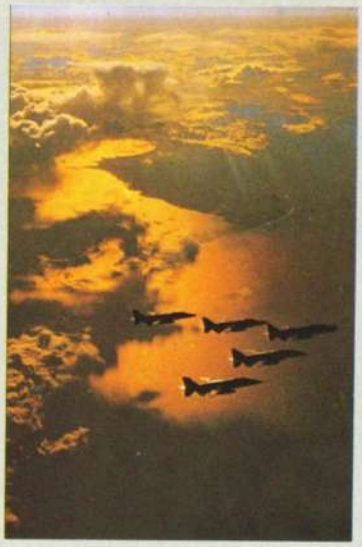

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